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Handbooks of the Flora and Fauna of South Australia, issued by the British Science Guild (South Australian Branch) and published by favor of the Honorable the Premier (Sir Henry Barwell, K.C.M.G.).

THE MAMMALS

OF

SOUTH AUSTRALIA.

By FREDERIC WOOD JONES, D.Sc.

Part I.

CONTAINING

The Monotremes and the Carnivorous Marsupials.

(The Ornithodelphia and the didactylous Didelphia.)

WITH ILLUSTRATIONS.

Price: FOUR SHILLINGS.

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1923

EDITORIAL PREFACE.

Handbooks of the Flora and Fauna of South Australia, issued by the British Science Guild (South Australian Branch).

Recognising the need for a wider diffusion of accurate knowledge of our Flora and Fauna, the Guild has undertaken the issue of a series of handbooks.

There is an admitted lack of inexpensive but accurate books dealing with the plants and animals of South Australia, and it is felt that the absence of such has been a real handicap to young Australia, and so to the progress of Australian science. These volumes, which have been planned to meet the want, are being prepared gratuitously by South Australian biologists and geologists: they will be printed and published by the State Government, and will be available for schools and the public generally.

INTRODUCTION.

To give a perfectly satisfactory definition of a Mammal is by no means an easy matter, but fortunately the general meaning of the term is so well understood that there is no need to labour the description of what may be considered as the essential characters which admit an animal to the zoological rank of the Mammalia.

Unfortunately there is no popular term which is a perfect substitute for the zoological designation of the Class. The word " bird " perfectly connotes the more scientific expression conveyed by the term " Aves." But neither " animal," nor " beast," nor " quadruped " can be considered as an adequate substitute for the term Mammal.

Without entering into details, the definition of which would be tedious, we may say that a Mammal is a backboned animal which has warm blood, and which possesses some measure of hairy covering. That its chest and its abdomen are divided from each other internally by a muscular partition which is called the diaphragm ; and that the great arterial trunk (the aorta), which arises from the heart, arches towards the left side of the body. Finally, to define the character which originally gave the name to the Class, the female is provided with cutaneous glands (mammary glands) which secrete milk for the nourishment of the young.

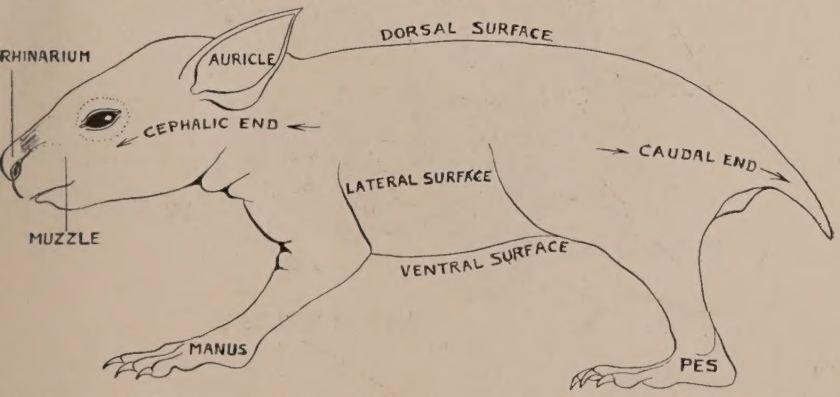


FIGURE 1.—Simple diagramatic representation of a mammal to indicate the principal descriptive terms used to designate the larger parts and aspects of the body.

Since the purpose of the present volume is to furnish an elementary guide to the Mammals inhabiting South Australia, all unnecessary technical details will be excluded. But with the best wish in the world it is not possible to proceed any distance in the study of even the most ordinary Mammal without coming across certain things to which names must be assigned, and for which familiar names are lacking.

If we wish to give the proper name to any Mammal it is necessary to examine it systematically and to measure it. Only then can it be classified, and its identity finally settled. Certain features require special examination, since all parts of an animal are not of equal importance in the determination of its status. Here we will be almost entirely concerned with external characters, but it must be remembered

that these external characters are not in themselves sufficient to diagnose, beyond all doubt, the proper position of an animal in the scale of nature. Other, deeper, and more complex details must be considered. Nevertheless, external characters alone will lead a long way, and it is, therefore, worth while to pay some systematic attention to them.

In order to make the description of the external characters of any animal sufficiently accurate and sufficiently complete to enable the creature to be identified from its description alone, it is necessary to adopt some order in dealing with the different parts and appendages of the body. It is also necessary to use some special terms to distinguish parts and surfaces, and since all of these terms are not in ordinary every-day use, certain of them stand in need of definition.

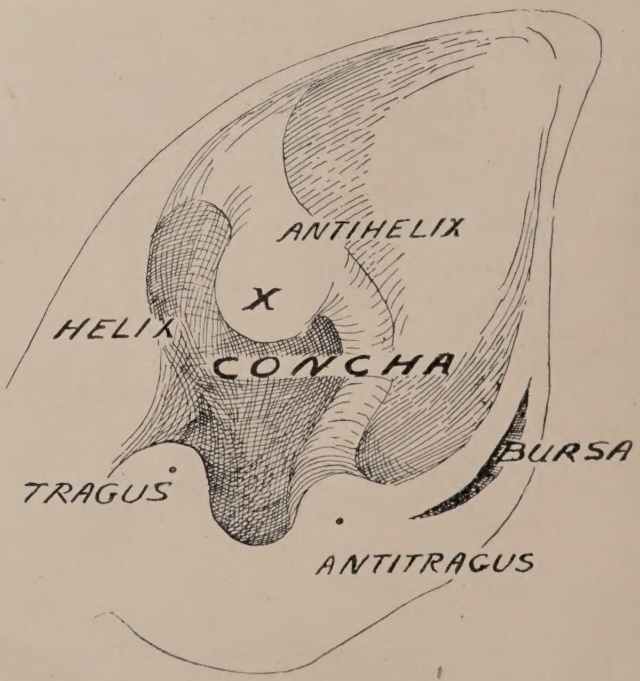


FIGURE 2.—Simple diagram of an external ear, or auricle. The process of the antihelix, marked X, is sometimes termed the *supratragus* or *metatragus*.

A diagramatic mammal has been represented in Figure 1, and reference to that illustration will explain the terms most commonly applied to the larger subdivisions of the body. The word *muzzle* is best retained as the term for the hairy snout, or prolongation of the face which carries the mouth and the nose ; while by *rhinarium* is meant only the actual opening of the nose, or the area in which the nostrils are situated. The mammalian rhinarium has very varying form, but it is usually covered by a specialised and hairless skin. The terms *manus* and *pes* are obviously better than hand and foot when applied to most mammals ; and they are shorter and more accurate than the expressions fore-foot and hind-foot.

The external ear or *auricle* is an important feature among the distinguishing characters of an animal, and some of the terms employed to denote its parts need explanation. In the diagramatic auricle represented in Figure 2, it will be noticed that the hollow portion or *concha* has a more or less definite rim or margin, which is most developed in front and behind at the points where the auricle joins the skin of the head. This outer rim is the *helix*. As variable processes developed from this rim are the *tragus* and *antitragus*, and in the hinder portion of the helix itself there is sometimes developed a curious little pocket called the *bursa*. Within the concha is another curled ridge, something like an inner margin to the auricle—this is the *antihelix*. From the antihelix there are developed certain processes in the same manner as the tragus and antitragus are developed from the helix. One of these processes is marked X in Figure 2. The terms used for these processes are rather confused in their use in zoological books. Sometimes they are called supratragus, sometimes metatragus, and sometimes tragoid projections—here they will be termed *processi antihelicis*.

Most mammals have in different parts of their bodies certain specialised bristly hairs, which usually grow from little elevations of the skin. The bristles are termed *vibrissae*, and the little round bases from which they grow are known as *papillae*. The function of these structures is to furnish accessory organs of touch, for the long

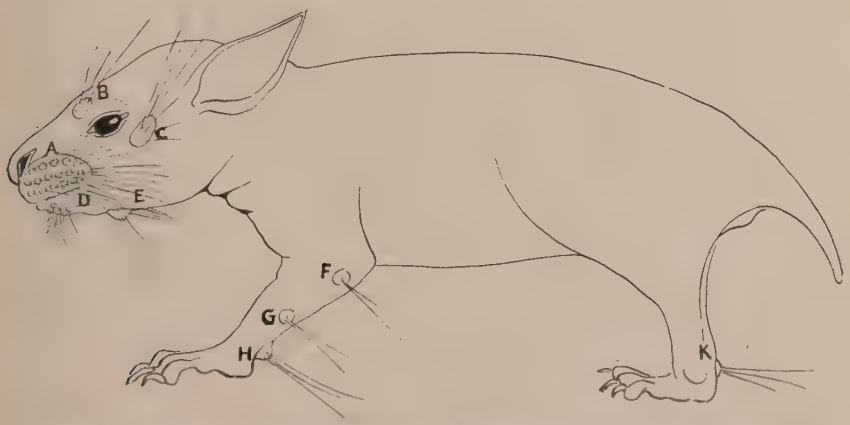


FIGURE 3.—Simple diagramatic representation of a mammal to show the distribution of the sensory papillae and vibrissae. The groups are classified as follows:—A, mysticial; B, supra-orbital; C, genal; D, submental; E, interramal; F, anconeal; G, medial antebrachial; H, ulnar carpal; K, calcaneal.

sensitive hairs coming in contact with outside objects help the animal to guide itself about with safety. The most familiar vibrissae are the well known "whiskers" of animals, and the twitching of the sensitive whiskers of a creature such as a rat is familiar to everyone. The vibrissae forming the whiskers are known as the *mysticial* group. Other groups are indicated in Figure 3, and they consist of, a set above the eye, *supraorbital*; a set upon the cheek, *genal*; a set under the chin, *submental*; and a set between the two sides of the lower jaw, *interramal*. Upon the limbs are other sets of these bristle hairs. There may be as many as three

separate groups upon the fore limb, the *anconeal* near the elbow; the *medial antebrachial* about half-way down the forearm; and the very constant *ulnar carpal*, just above the wrist. Upon the hind limb there is only one set, and that, being situated upon the inner side of the ankle, is called the *calcaneal* group.

Of all the external appendages and parts of the animal's body the manus and pes are perhaps the most important as affording evidence on which to judge of the nature of the creature owning them. By a careful study of the manus and pes most of the mammals of Australia can be readily assigned to their proper group, and in many cases the actual identity of the animal can be absolutely established. In studying hands and feet note must be made in the first place of the number of *digits*. The typical mammalian number is five; but in many animals the number has become reduced by the loss of certain digits from the manus or pes. Then, the relative length of the digits, as they radiate from the palm, differs in various animals. In what may be considered the typical condition, the 3rd or middle digit projects farthest, and the 2nd and 4th next farthest, the 5th being next, and the 1st being shortest of all. The arrangement of digits in order of their relative length may be expressed as a *digital formula*, and in the case we have considered, and illustrated at Figure 4, the formula would be written $3 > 2 = 4 > 5 > 1$: the sign $>$ standing for "longer than" and $=$ meaning "same length as."

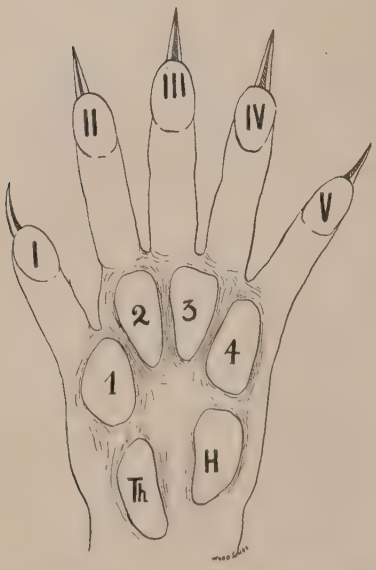


FIGURE 4.—Simple diagram to explain the naming of parts of the palm or sole. I., II., III., IV., V. mark the typical 5 digits. The figures being placed upon the 5 apical pads. 1, 2, 3, 4 denote the 4 typical interdigital pads and Th. and H. the thenar and hypothenar pads respectively.

At the ends of the digits there may, or may not be well developed pads or little cushions; these are termed *apical pads*, and they are marked from I. to V. in Figure 4. Upon the palm, which may be wholly or only partly naked, and may be covered by skin of very varying texture, are other cushions, one being situated typically at the base of the cleft between each pair of digits: these, numbered from 1 to 4, in Figure 4, are the *interdigital pads*.

In addition to these, there may also be a pad situated on the palm near the base of the first digit, the *thenar pad*; and another near the base of the fifth digit, the *hypothenar pad*. A typical mammal may therefore show five digits, and eleven pads, all constituted in a definite and characteristic fashion: or it may show a reduction in the number of its digits and pads; and all these things are to be noted in the description of the animal.

Although not so readily open to examination as the ears and feet, the teeth may still be reckoned among external characters, and the evidence provided by

an examination of the dental characters is always of the greatest importance, since teeth are so relatively indestructible that they may be all that is left of an animal long since extinct. It is possible that nothing more than the evidence afforded by the teeth may serve to link a living animal to its long extinct ancestor. To determine the number and the kind of teeth present is not a difficult task; but the description of the form of the teeth and the details of all the little elevations or cusps on the surfaces of the back teeth is a business involving far too many technical terms to be attempted here. There are, roughly, three kinds of teeth in the mouth of a typical mammal—the cutters or *incisors* in front, the piercers or *canines* behind, and the grinders or cheek-teeth behind that. The cheek-teeth are again subdivided into two sets, the blunt grinding posterior *molars* and the sharper anterior *premolars*. The animal whose teeth are shown at Figure 5 has a

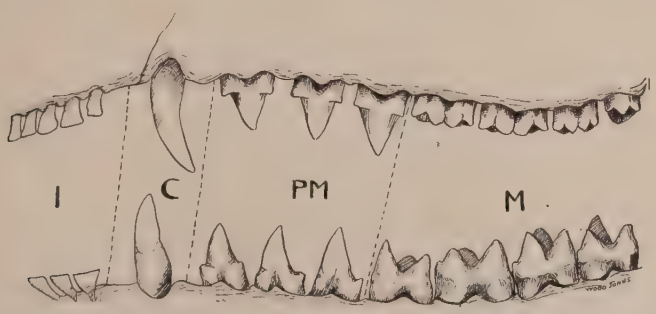


FIGURE 5.—The upper and lower teeth of the left side of the Short-nosed Bandicoot to show various kinds of teeth—I=incisors, C=canines, PM=premolars, M=molars.

very representative dentition which consists of 5 upper and 3 lower incisors on each side; a single upper and a single lower canine on each side; 3 upper premolars, 4 upper molars, and the same number of these teeth in the lower jaw upon the right and left sides of the mouth.

These facts may be incorporated in what is termed a *dental formula*, which is merely a numerical expression of the complete set of teeth present in the animal. In the case depicted in Figure 5 the formula would be as follows:—$I\frac{5}{3}\cdot\frac{5}{3}\cdot C\frac{1}{1}\cdot\frac{1}{1}\cdot PM\frac{3}{3}\cdot\frac{3}{3}\cdot M\frac{4}{4}\cdot\frac{4}{4}$., the actual animal illustrated being the Short-nosed Bandicoot (*Isoodon obesulus*).

From time to time references will have to be made, in the ordinary course of distinguishing an animal, to certain characters of the skull. Cranial characters will be omitted wherever possible, but in some instances their importance is so great that they cannot be passed over completely. In most cases a figure of the skull will be considered sufficient, but at times this will have to be amplified in the text, and therefore it is necessary to call attention to certain technical terms, and some unfamiliar names for bones. In order to make these names clearer Figures 6, 7, and 8 have been inserted. The drawings have been made from the skull of the so-called Tasmanian Wolf (*Thylacinus cynocephalus*), for although it is not at the present day a living inhabitant of South Australia, it lived here in comparatively recent times. In most text books of Zoology the bones of the skull are illustrated

by reference to figures of the cranium of the domestic dog. The dog's skull is the type usually chosen for systematic study. The skull of *Thylacinus* is in its general rough outlines so like that of a dog that the reader who cares to proceed further

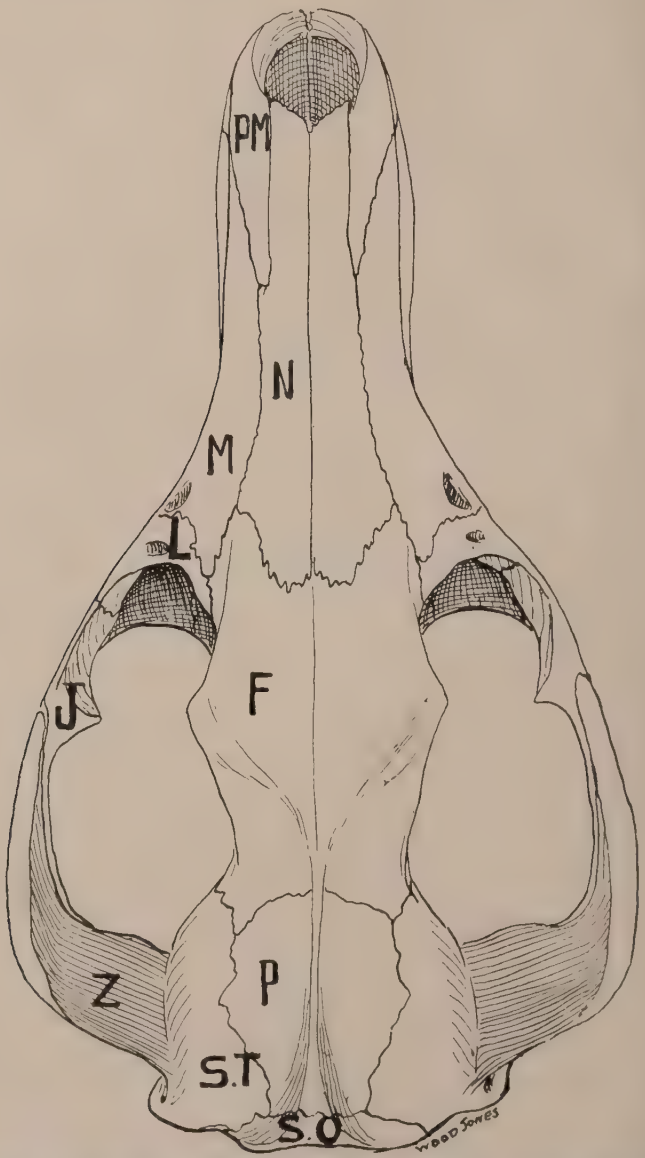


FIGURE 6.—Dorsal view of the skull of *Thylacinus* to show the principal bones entering into its formation. PM—premaxilla, M—maxilla, N—nasal, L—lachrymal, F—frontal, J—jugal, Z—zygomatic, P—parietal, ST—squamous temporal, SO—supraoccipital.

will derive a good insight into some of the most curious mammalian problems by noting not only the generalised likeness, but the specialised total unlikeness of the

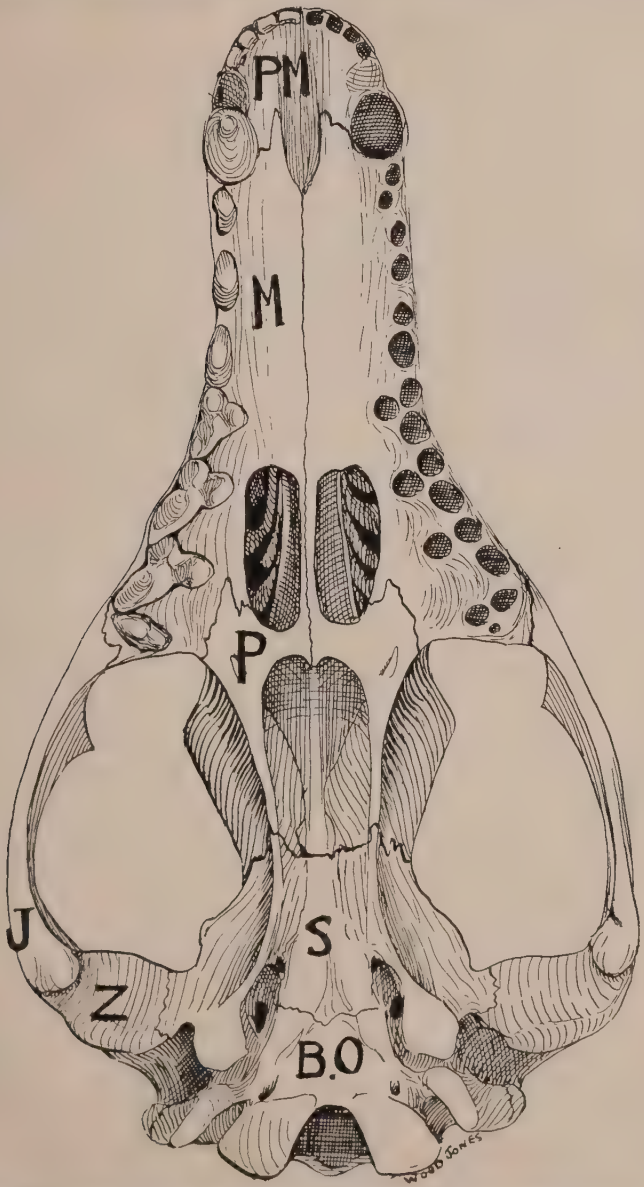


FIGURE 7.—Ventral view of the skull of *Thylacinus*. PM—premaxilla, M—maxilla, P—palate, J—jugal, Z—zygomatic, S—sphenoid, BO—basioccipital.
The teeth have been removed on the right hand side of the figure in order to show the sockets for their roots.

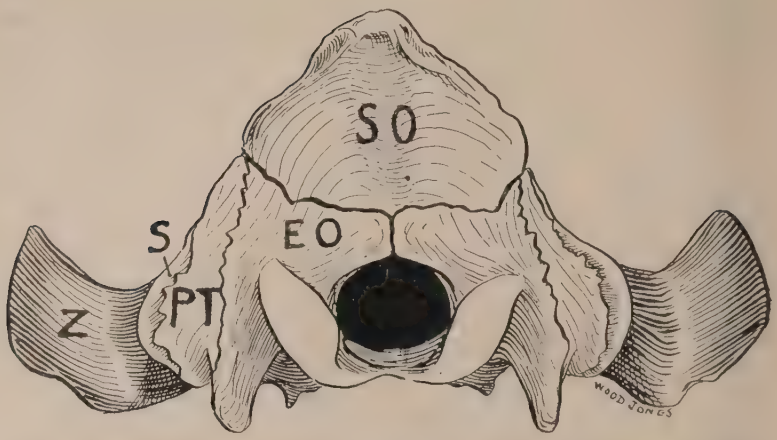


FIGURE 8.—Caudal view of the skull of *Thylacinus*. SO=supraoccipital, PT=petrous temporal, S=squamous temporal, Z=zygomatic, EO=exoccipital.

two types. The illustrations are intended to be a guide to enable the reader to distinguish the main parts of the skull, and descriptions of individual bones will not be given until the occasion arises.

FIGURE 9.—Diagram to illustrate the correct method of measuring the length of the tail and of the pes.

In addition to the examination of the various parts of the body, it is necessary to take a series of accurate measurements of the animal in order to settle the question of its identity. To be of any real use these measurements must be made in a constant and definite manner. All measurements are, of course, recorded in the metric system. First, the total length of the head and body should be recorded by measuring from the tip of the snout to the base of the tail, along the curve of the back. This measurement should be taken with a tape, and the animal should be straightened out as much as possible without being unnaturally stretched. Next, the length of the tail should be taken in the way shown in Figure 9. The terminal tuft of hair on the tail should not be included in the measurement. The ear should be measured from the notch at its base to the most distant point of its tip, the method of taking the measurement being shown in Figure 10. The hind foot should be measured from the part which represents the point of the heel to the tip of the most distant toe, but the

claw must not be included in the measurement. There are several other less important measurements of the body, and parts of the body, but these need no special directions for their recording and they will be defined as they arise.

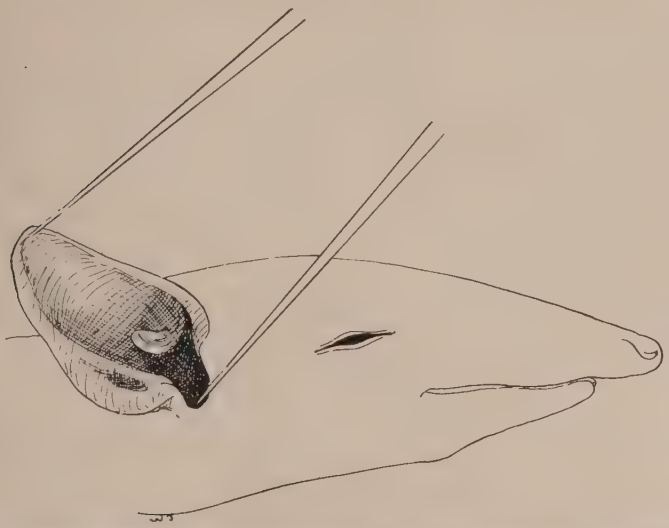


FIGURE 10.—Diagram to illustrate the correct method of measuring the length of the external ear.

All measurements recorded in these pages are made upon recently dead or spirit preserved animals, except where otherwise stated.

CLASSIFICATION OF THE MAMMALS.

An assemblage of animal forms so large as the Class Mammalia embraces types which differ from each other by structural alterations which are, at times, very considerable. For this reason it becomes necessary to split up the main Class into smaller Sub-classes, each Sub-class containing a certain number of forms which are obviously united to each other by a natural common structural bond, but which differ by the possession of some structural feature from members of the other Sub-classes. Some definite scheme of classification must be employed in order to reduce the study of the Mammals to the position of an ordered branch of knowledge.

Many schemes for the classification of the Mammals have been proposed, and here we will adopt one of the oldest, and certainly the simplest, of the systems that have been put forward since the knowledge of the Mammals was sufficiently precise to warrant the drawing up of such classifications. So long ago as 1816, M. de Blainville pointed out that all Mammals fell into three distinct groups, when the characters of the reproductive system of the female were taken as the criteria on which to estimate their rank. In the one group the internal genital system of the female presented certain general resemblances to the condition seen in birds. This group he, therefore, termed *Ornithodelphes*. In the second group the internal genital system of the female was essentially double, the right and left halves remaining separate. For this reason he termed his second group *Didelphes*. In the third group the two bilateral halves of the female internal genitalia are united into a single middle-line structure ; and since the system was essentially single, he named this group *Monodelphes*.

These three terms, altered by Greek terminations into *Ornithodelphia, Didelphia*, and *Monodelphia*, although widely employed formerly, have, to a great extent, passed from modern scientific usage. The reason for their present disuse is that they have been replaced by the symbols stereotyped by Huxley in 1880 for the three basal Mammalian groups. Huxley employed two terms previously used in 1872 by Gill, and added a third ; but he somewhat altered the connotations of the terms. Gill had introduced the word Eutheria and had adopted from Lamark (1809) his term Prototheria : Huxley then added a third, Metatheria, and employed them to represent the three basal groups, of which de Blainville had labelled the actual members with his three simple terms. Thus the term *Eutheria*, as used by Huxley and by most modern naturalists, is practically the equivalent for Monodelphia, the term *Metatheria* for Didelphia, and the term *Prototheria* for Ornithodelphia.

There is a modern tendency to return to the two primary groups as pictured by Gill, and this is effected by uniting the Metatheria and the Eutheria as subdivisions of a single group termed *Theria*.

In the present volume the original three Sub-classes will be retained, and the original names used by de Blainville to distinguish them will be employed. Some explanation for this apparently retrograde step must be given. Huxley's scheme has the advantage of being easily capable of extension to extinct or to hypothetical creatures, of which the structure of the internal genitalia cannot be known; but

it has the great disadvantage of implying an inter-relationship between the three groups, which, although assumed by Huxley, is now well known not to represent the affinities, or the evolutionary sequence of the groups. On the other hand, the terms used by de Blainville are simple, and they imply no more than we are actually certain of; their aptitude may be readily demonstrated by the ordinary methods employed in the study of anatomy; they can be tested and understood by anyone.

That the Didelphia and Monodelphia are here kept as separate Sub-classes, and are not united into the single group Theria, is defended on the grounds that the anatomical differences between the two groups are great enough to justify the separation. An anatomical distinction need not be very striking in its manifestation in order to rank as a great distinction, but it may involve some item of body-building so fundamental that its real significance outweighs its apparent minor character. The anatomical differences between the Didelphia and the Monodelphia are of this fundamental nature. For the purposes of the present volume it will be enough to say that, whereas in the Didelphia the ducts of the kidneys (ureters) run between the female genital ducts (oviducts), in the Monodelphia the oviducts run between the two ureters. It is this alteration of what may be termed ground-plan anatomy which accounts for, and creates, the striking differences between the reproductive systems in the two Sub-classes.

There are other terms which are employed to denote the separate Sub-classes, but these names are best relegated to subordinate rank. The terms "higher mammals" or "placentals" are not satisfactory substitutes for Monodelphia: "marsupial" or "pouched animals" are not true synonyms for Didelphia; and the term Monotreme is best employed, not as a substitute for Ornithodelphia, but as the name for the Order in which the living Ornithodelphians are placed.

The distinguishing features of the three Sub-classes will be dealt with more fully when the actual members of the Sub-classes are considered; but meanwhile it is well to separate the Sub-classes using only a minimum of features, and employing only a minimum of technical terms.

Sub-Class I.—ORNITHODELPHIA.

(MONOTREMATA, or PROTOTHERIA.) *See* Figure 11.

The genital ducts of the female (oviducts) are simple, and are entirely separate from each other in the whole of their length. They open into a chamber, which is common to them and to the outlet of the urinary system, and is termed the *Uro-genital Sinus*; this uro-genital sinus opens into another chamber into which the outlet of the intestinal canal also opens. The final chamber is known as the *Cloaca*, and it opens to the exterior by a single opening which is under muscular control. In the male the genital ducts (vasa deferentia) also open into the Cloaca, and not into a urethral canal such as is found in other mammals.

The mammary glands are diffuse, and the secretion which is made in them exudes from multiple apertures on the skin of the abdomen, there being no nipple to provide a discrete opening for the ducts.

The young are produced from thin-shelled eggs. A temporary pouch, or *Incubatorium*, is developed in some forms for the reception of the egg and for the protection of the newly-hatched young.

Examples.—The Native Porcupine (*Echidna*) and the Platypus (*Ornithorhynchus*).

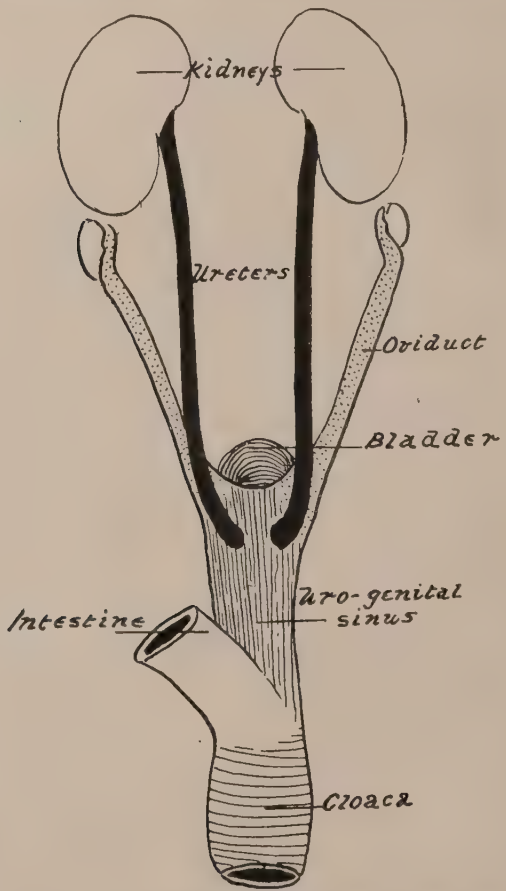


Figure 11.—Simple diagram of the female reproductive system as it is present in the *Ornithodelphia*. The parts are viewed from the dorsal surface.

Sub-Class II.—DIDELPHIA.

(MARSUPIALIA, or METATHERIA.) *See* Figure 12.

The genital ducts of the female are specialised, there being a well-marked uterine portion. The uterine portions of the two sides, however, remain entirely separate, and do not unite in the middle line to form a single median uterus. The separated uterine portions of the oviducts join separated lateral vaginae, and the lateral

vaginae open into a uro-genital sinus common to them and to the outlet of the bladder. The uro-genital sinus opens to the exterior by an orifice, which, although separate from that of the intestinal canal, is encircled, with that orifice, by a common ring.

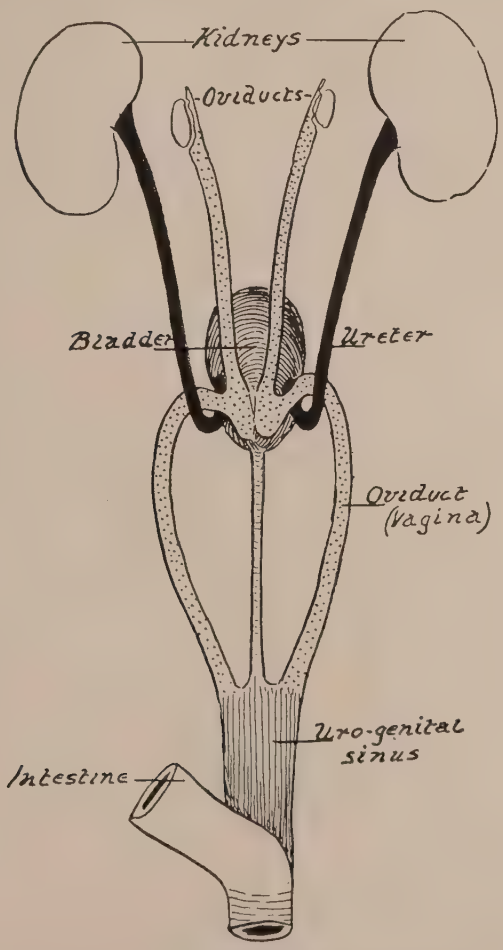


FIGURE 12.—Simple diagram of the female reproductive system as it is present in the *Didelphia*. The parts are viewed from the dorsal surface.

The cloaca, which is a deep chamber in the Ornithodelphia, is represented in the Didelphia by a depression of varying degrees of shallowness, but which in all conditions has an individual muscular mouth.

The ducts of the kidneys (ureters) pass between the genital ducts. The genital ducts in the male open into a complete urethral canal as they do in the Monodelphia. The mammary glands are provided with particularly well-developed nipples, and

they are typically situated within a skin fold on the surface of the abdomen which is known as the pouch, or *Marsupium*. The young are born alive, after a short period of utero-gestation, and they are born in an immature condition. For a variable period their post-natal life is spent clinging tightly to a nipple within the marsupium.

Examples.—Kangaroos and Wallabies, Native Cats, Opossums, Bandicoots, and all the rest of the native or pouched animals.

Sub-Class III.—MONODELPHIA.

(PLACENTALIA, EUTHERIA, or HIGHER MAMMALS.) *See* Figure 13.

The genital ducts of the female are specialised, there being well marked uterine portions, which typically unite to form a single median uterus. The uterus opens

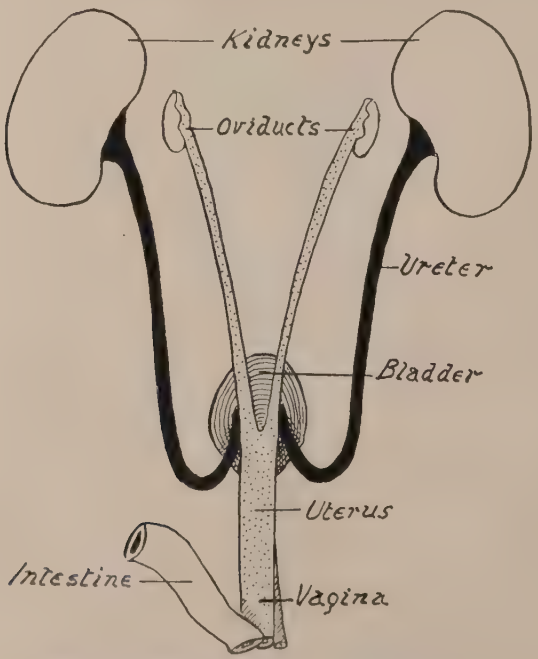


Figure 13.—Simple diagram of the female reproductive system as it is present in the *Monodelphia*. The parts are viewed from the dorsal surface.

to the exterior by way of a single median vagina. The *ducts of the kidneys* (*ureters*) *pass on each side of the genital ducts*. The genital ducts of the male open into a complete urethral passage. The mammary glands are discrete: they are provided with nipples, and they are situated on the ventral surface of the body at varying

points along two lines (mammary lines) which stretch from the front of each armpit to the root of the tail. The young are born alive after a varying, but more or less prolonged period of utero-gestation, in a condition of considerable, but widely varying, maturity.

The young obtain their nourishment at intervals from the maternal mammary glands, but they are not retained suspended from the nipple, nor sheltered within a skin-fold of the maternal ventral surface.

Examples.—Rabbits, Rats and Mice, Cats, Cattle and Sheep, and all the rest of the non-pouched animals.

Of the three Sub-classes, the Ornithodelphia comprises the most lowly Mammals, which display in their structure and functions the greatest resemblances to the lower vertebrates. These animals are confined to Australasia. The Didelphia are, in many features, considerably less developed than the Monodelphia, and they are at the present time confined to Australasia and to the southern portion of America. The Monodelphia, the most perfect expressions of mammalian development, may be said to have overrun the whole Earth.

SPECIAL PROBLEMS CONNECTED WITH THE MAMMALIAN FAUNA OF AUSTRALIA.

There is no other mammalian land fauna around which problems centre with such crowded possibilities for speculation; no other land, the mammalian colonists of which afford a like interest both in the manner of their advent, and in the fashion of their forms. For the zoologist, the palaeontologist, and the physiographer, the study of the Australian Mammals presents a field of research of the utmost interest and importance.

The Australian continent is known to have had a long period of geographical separation from the other large land masses of the globe. It is known that its separation occurred after the Didelphian Mammals had had their opportunity to populate it by coming in from the adjoining land masses; and that it occurred before the Monodelphian Mammals had opportunity to follow them by any considerable land bridges.

There are various portions of the Earth's surface which may be described as "dead ends," as outliers of land areas which have become, more or less completely cut off from the rest of the world. Into these dead ends a fauna may be driven, as fugitives before some advancing danger; and from these dead ends it may be the fugitives have no outlet. At one period Australia constituted such a dead end; but, after it had received its population of Ornithodelphians and Didelphians, it became cut off from adjoining land masses; and to-day it constitutes the great example of an isolated dead end, a faunal asylum completely severed from all the rest of the world. It is a place into which a definite phase of the developing animal series has penetrated, and become imprisoned; and thus has been preserved undisturbed by subsequent developments in the animal kingdom.

Herein lies the great interest of the study of Nature in Australia, for Australia constitutes the great natural reserve for the world's archaic forms, and every Australian should regard himself as a custodian who is responsible for the conservation of these creatures. Exactly when and where the Australian mammalian fauna came into existence does not greatly concern us; we know at any rate that it did not originate in Australia. During Mesozoic times the Didelphia flourished in Europe and in North America. In Europe they became extinct in the Tertiary period; and in America they were driven South, on the road to the dead end of South America, where they linger to the present day. Probably begot in the connected northern land masses, they were driven by the better endowed Monodelphians into the dead ends of the earth. The Monodelphians, with superior intelligence and better equipment, pushed them in front, and drove them by successive waves down the great American continent, until now they have a rather slender footing in the southern portions of the New World. The same pressure probably drove them across Asia, and thence to the land bridge now represented by the islands to the South and East of the Malayan chain. By the same process of the perpetual stress of competition with the superior Monodelphians, they were driven into Australia, which, at the time of their advent, was connected with other landmasses of the globe.

By what actual route did the Didelphians reach Australia? It is possible that Australia was then connected, in the region of Torres Straits, with a land bridge now represented by the Malayan chain of islands. It is also possible that Australia was connected with a southern continent of Antarctica and so with South America. Did the Marsupials, driven into the dead ends, come in by a northern connection, or did they come in by the south? There are advocates who plead with much cogency, and with a great weight of authority, for each of these views. Tasmania has its Ornithodelphians and its Didelphians, and possesses, as living forms, some outstanding species which are unrepresented among the existing fauna of the mainland of Australia. It possesses also, as fossil remains, an extremely primitive creature named *Wynyardia*, which seems to have been a possible ancestor of several of the modern types of Australian marsupials. It is permissible to argue that, since Tasmania has a comparatively rich marsupial fauna, and as the marsupials become successively poorer in genera as we pass northwards in Australia, the route of immigration was from the South. We may postulate that the marsupials, driven into South America, invaded Antarctica, or some other lost land mass between South America and Australia; that from here they invaded Tasmania, and thence, by an undoubted land bridge, peopled Australia and spread northwards to the southern islands of the Malayan chain. Many people believe that such has been the actual progress of the marsupials.

But there is an alternative view. We may assume that the animals were driven along two divergent routes, on the one hand into the dead end of tropical America, and on the other along the land connections of the Malayan chain. And from the Malayan chain they came by land bridges into Australia, and finally into Tasmania. This view is the one adopted here.

If we take certain archaic animals which belong to the Monodelphia, we can follow their dispersal more easily than we can that of the isolated Didelphia. One of the most primitive forms of the hoofed animals (Ungulates) is the Tapir. The history of the Tapirs seems to be clear enough. They were driven from a northern centre of dispersal down into Central America, where they exist to-day as *Tapirus* (*Elasmognathus*) *bairdi*, and *T. dowi*. They went further South, and entered South America where they are represented by the living forms *T. terrestris* and *T. roulini*. By a divergent route the stock was also driven to the Malayan chain — Malay Peninsula, Sumatra, Java, and Borneo — where its modern descendents are known under the name of *T. indicus*. The living Tapirs are therefore confined to the Southern portion of the great American continent, and to the Malayan chain; but their northern origin seems clear. The ancestral form is found in France and in Germany, in deposits as old as the Miocene, and in the Red Crag of Suffolk in England, and this ancestral form is represented by such types as *T. priscus* and *T. arvernensis*. The Tapirs never reached Australia, no available land bridge being in existence at the time of their arrival at the threshold of the Australian continent.

The same facts are again demonstrated by the present distribution of the Edentates, a lowly Order of the Monodelphia. In South America there are the Sloths and Armadillos; in South Africa the Aard Varks; and in the Malayan chain the Pangolins. All are primitive creatures. All have presumably been driven into the dead ends of the Earth; but driven into them after Australia was isolated.

Moreover, this same story is unfolded when we inquire into the distribution and dispersal of a host of other land creatures.

The view that the marsupials were driven into Australia, and thence into Tasmania, by land bridges existing to the North is, therefore, supported here. But to uphold such a thesis is not to deny the former southern connections of the Australian continent. The argument that the Marsupial population is richer and more diversified in the South, we would meet by saying that this is the expectation if the fauna were driven in from the North. We know that the Celtic race was driven westwards in the British Islands by invaders from the East; and the fact that we find the Celts more pure and more dense on the western confines of Britain does not lead us to suppose that the West was their point of entry. The scattered Marsupials of the Malayan chain we would regard, not as the farthest driven outliers of the Australasian marsupials, but as the locally settled members of a migrating race. The denser population of marsupials of southern Australia and Tasmania we regard not as the immediate immigrants, but as the pioneers advanced towards the farthest confines of their territory. Granted that the marsupials were driven in by pressure of the Monodelphia, and by way of land bridges from Malaysia into Australia, it is necessary to postulate that, after the entry of the marsupials, these land bridges were severed, and the isolation of Australia was complete, else would a hord of monodelphian Mammals have entered in their wake. But though the land bridges, which connected Australia with the northern land masses, were broken after the advent of the marsupials, nevertheless, certain animals, representative of the Monodelphia, managed to find their way into the isolated continent.

The first class of the Monodelphian immigrants—the marine animals, such as the seals and whales—offers no outstanding problem. The sea was theirs to traverse as they pleased; and they came to the shores of Australia, as to the shores of other lands, as mariners. As Cook and Flinders came to Australia, so did the seals and whales, by ocean highroads.

The second group—the bats—likewise offers no problem. Theirs was the realm of the air, and they cared not for land bridges. As bats have peopled the islands of the Pacific so they have peopled Australia. They have taken up their abode here and have become modified, and have given rise to a definite type of Australian Chiropteran fauna. Their colonization is evidently an old standing achievement.

In the third group come the Rodents—the rats and mice. These were early immigrants, but their dispersal is probably due to precarious means; they also do not need a land bridge in order to people distant lands. We know that oceanic islands receive their rat population by floating islands, by floating logs, and by flotsam and jetsam of all sorts. It is not necessary to postulate a land bridge in order to supply an isolated land area with rats and mice. Christmas Island in the Indian Ocean may be taken as an example. Though a true oceanic island without any former land connections, and situated over five hundred miles from the nearest land, this island received its murine fauna sufficiently long ago to permit of the local development of two outstanding types of rats, specifically different from all the rest of the rats and mice known from other parts of the world. We know that the introduction of rats and mice into Australia must have been very early, for the bones and teeth of several species are found in cave deposits all over Australia, associated with the bones of marsupials which have since become extinct. We

may also assume that the murine Rodents are old inhabitants of Australia, because of the great specialisation which is displayed by many Australian species. The Australian Water rat (*Hydromys*) is a very remarkable animal, which is essentially an Australian specialisation; and many of the rats from the more arid regions of the centre are typical products of the country, and have evidently been long established. Almost certainly they came to Australia without the help of land connections, otherwise the monodelphian Insectivora and Carnivora would have accompanied them.

Despite the speculations that have for many years been rife concerning the status of the Dingo, this animal is probably surrounded by a romance altogether different from that attaching to the Water rat. The special characters of the Dingo will be dealt with in their proper place, and here we may dismiss it as being the black-fellow's travelling companion—the dog that came, certainly in the remote past, in company with his master the Australian aboriginal.

Long after the aboriginal came with his dog, the white man tried his hand at introducing his domesticated animals, and some that were not domesticated. As in so many other cases, man has meddled with Nature with disastrous results. In the isolated Australian continent the Ornithodelphia and Didelphia existed untouched by the competition of the better equipped Monodelphians; they lived safe from the superior craft of any carnivorous member of the higher Mammalia. The black man and his dog were their first formidable enemies, and probably the fate of the largest and most peculiar of the Marsupials was sealed by the advent of the aboriginal and the dingo. Yet what the aboriginal and the dingo have accomplished in the way of extermination is as nothing compared with the more modern havoc wrought by the white man with his firearms, his traps, and his poison; by his dogs and cats, and by his most destructive introduction, the fox.

Apart altogether from the interest of the Australian Mammals as immigrants to their isolated home, apart too from their intense importance as an archaic and a dying fauna, there is the valuable light which their study is capable of throwing on certain general biological problems. The peculiar Australian Mammals provide the student with one of the grandest and most instructive examples of the phenomenon known under the name of *Convergence*. In order to appreciate this very fundamental and important biological principle, it is best to take a purely imaginary case and study it in a perfectly abstract way, remembering always that the hypothetical can readily be replaced by the actual, when appeal is made to the facts of palaeontology and zoology: and that the abstract study can always be made concrete when knowledge and opportunity afford materials for research. Suppose some animal stock to become domiciled in a particular geographical area, which presents a particular type of environment suitable to the wellbeing of the stock. The stock will multiply, and with the increase in the number of individuals, there will be a tendency to spread from the original centre of domicile. As the individuals range further afield, it is likely that they will come to invade new areas which present, in some degree or other, environments differing from that of the original centre of domicile. From a desert region, for instance, they may invade forests, or from forests they may invade mountains or plains. In their radiation they may encounter all those different environmental stations which the physiography, and the climate, of the land masses of the world afford.

Now it is generally recognised that the forms of life typical of any specialised environment are modified in harmony with the demands of the environment. We recognise a typical desert fauna, and we know that, broadly speaking, living things have to become adapted, by some means or other, to their environment, or else they will cease to exist. It will be seen, therefore, that in the imaginary case we have been considering, the stock, which is radiating from a centre of domicile into areas affording differing environmental conditions, will tend to become adapted to the different environments, by a series of changes in habit and form, each change being in harmony with the peculiar circumstances in which the radiating stock happens to find itself.

The actual effect that will be produced in this way is that the radiating descendents of the original stock may become differentiated into a series of modified forms, each form adapted to its new station : the number and distinctness of the new forms being dependent on the variety and the distinctness of the new environments. The hypothetical original stock may be an arboreal one inhabiting a forest region, some of its radiating members may come to dwell on plains and adopt a cursorial life, and become structurally impressed with its accompanying physical adaptations. Some may encounter lakes or rivers, and become modified for an aquatic life ; some may burrow underground, and become adapted to fossorial habits. Some may take to the air and become volant ; some to leaping and become saltatory, as opportunity and circumstance demand. Again, as the radiating stock encounters new environmental conditions, its opportunities for obtaining food may vary ; some members may become domiciled on grassy plains, and become herbivorous, grazing animals ; some may inhabit bush country, and adopt a browsing method of obtaining vegetable food ; and some may find insects, or other animals, more suited to their new physiological demands, and so become insectivorous or carnivorous. In any case the change in the method of obtaining food will lead to changes in the type of the creature, and the adaptations will be in harmony with the demands of the environment.

We may say, therefore, that a stock will become progressively altered by adaptations to its environment as it radiates from its centre of domicile, and this, in brief, is a statement of the Law of Adaptive Radiation. Let us now take the concrete case of the marsupial fauna of Australia. We have seen that the original stock came to Australia, by some route or other, as colonists from the other land masses of the globe. Arrived in Australia, they found a land presenting almost every conceivable type of environment. There were trees up which they could climb and lead arboreal lives. The Australian Phalangers commonly, but wrongly, known as Opossums, are typical examples of arboreal animals. They could over-specialise as tree climbers and become, in the end, condemned to a life spent clinging to branches ; and of this over-specialisation the Koala (*Phascolarctus cinereus*) is a notorious instance. There were open plains over which they could run and become cursorial, and although no marsupial has become a definite hoofed animal, nevertheless the Pig-footed Bandicoot (*Choeropus castanotis*) shows certain structural modifications along the lines that have led to the development of typical hoofs in other running stocks. The bulk of the marsupials which came to inhabit open country took to leaping and becoming saltatory animals, and no better examples of saltatory modifications could be found than those seen in the kangaroos and wallabies.

Again, in certain situations, an aptitude for burrowing may prove of the utmost importance to an animal, and the Bandicoots are good examples of animals which burrow both in search of food and of shelter.

The habit of burrowing may easily lead to such profound modifications of structure that the animal becomes unfitted for any life save that spent delving in the soil. The animal known as the Marsupial Mole (*Notoryctes typhlops*) has taken to this mode of life, and become a most completely specialised fossorial animal. Water, in the form of rivers, creeks, and lagoons, was present in Australia for the marsupials to take possession of, but it is a strange thing that no Australian marsupial has taken to an aquatic, or even a semi-aquatic life; no Australian Didelphian has become modified for life in the water. It might be thought that a pouched animal was debarred from living in the water by the mere fact of its possessing a pouch: but in South America a true Opossum (*Chironectes*) has made a conquest of the water. The Ornithodelphian Platypus and the Monodelphian Water rat are Australia's own aquatic animals.

But, whilst all these different surroundings and opportunities were open to the marsupial stock confined in Australia, it must not be forgotten that a similar series of varied environments was available to the Monodelphia present in the other land masses of the globe. The Monodelphia could radiate and become adapted, and their adaptations naturally followed the same lines as those that we have been picturing among the Didelphia. It therefore happens that, taking the Didelphian series on the one hand and the Monodelphian series on the other, it is possible that similar environments having demanded similar adaptations, certain members of the one stock might well have come to resemble, in rough general likeness, some members of the other.

A fossorial marsupial, for instance, might come to resemble in certain adaptive features, a fossorial member of the Monodelphia; and it is possible to imagine that, with a high degree of specialisation, the general resemblance might come to be very exact. The production of such likenesses between members of different stocks constitutes the phenomenon known as Convergence. As illustrations of this phenomenon we may give the following instances. In Africa, in Asia, and in South America are certain Rodents which have become protected from their enemies by the production of an armour of spines or quills. In general gross external details these animals—the true Porcupines—are so like the Ornithodelphian *Echidna* that this Australian animal, when first made known to science, was ranked near to them in the zoological scale; and even now, although its zoological position is quite well established, the animal is still known in South Australia as the Porcupine, or the Porcupine Ant-eater, or the Native Porcupine.

A similar convergent adaptation is seen in the great Monodelphian group of the Insectivora, and the Hedgehogs of the Palaearctic, Oriental, and Ethiopian regions display the same spiny coat and the same general likeness to *Echidna*, which is therefore sometimes known as the Native Hedgehog.

Certain aboreal Monodelphians, such as the Kinkajou (*Cercoleptes caudivolvulus*), have become modified in their general build of body, as well as in the details of their manus, pes, and prehensile tail, so that they resemble, in most superficial features, the Didelphian Phalangers, wrongly known throughout Australia as Opossums. Certain of the Australian arboreal marsupials have taken to a parachute method

of gliding through the air, and the Monodelphian convergent mimics of these Flying Phalangers (*Petaurus*, &c.), are found in such forms as *Anomalurus*—the Flying Squirrels of Central Africa and in *Pteromys* and *Sciropterus*—the Flying Squirrels of the Oriental Region.

The Australian arboreal marsupial, the Koala (*Phascolarctus cinereus*), which has over-specialised in its arboreal adaptations, and become reduced to the condition of a tree-clinger, finds its Monodelphian parallel in the South American Sloths (*Bradypodidae*) and in the members of the Asiatic Lemurine Genus *Nycticebus*, known as the Slow Loris.

Of the Australian marsupials which have learned to scratch holes in the earth, to provide places for their retreat, one, *Thylacomys lagotis* (the Pinkie or Thulka) has so great a general likeness to a Rodent as to be frequently called the Native Rabbit, and the others (the smaller Bandicoots) have a remarkable resemblance to the Monodelphian rats of the other parts of the world. More striking still is the wonderful convergent mimicry of the Marsupial Mole (*Notoryctes typhlops*) to the true Moles (*Talpidae*), and especially to the Golden Moles (*Chrysochloridae*) of the other land masses of the globe.

The only true cursorial animal developed from the Australian marsupial stock (*Choeropus*) shows several features which mimic in a very close way the modifications seen in the Monodelphian cursorial Rodents and Ungulates.

The saltatory marsupials, of which the Kangaroos are the most perfect example, have their Monodelphian parallels in the Rodent Jerboas (*Dipus*) of Africa, and the Insectivorous Jumping Shrews (*Macroscelididae*) of the Cape, as well as in the indigenous jumping Rodents (*Notomys*) of Australia.

Again, a similar specialisation in diet may effect parallel changes in the two stocks. In this way the carnivorous Didelphian Dasyures have become so like the Monodelphian Carnivora that they are universally known in Australia as Tiger Cats and Native Cats. The little insect-eating marsupials, such as those included in the Genus *Phascogale*, generally known as Pouched Mice, are singularly like the so-called mice and shrews which belong to the Monodelphian Order of the Insectivora. A dependence upon ants as a source of food supply has profoundly altered the Ornithodelphian Porcupine Ant-eater in all things connected with the jaws and tongue, in a way similar to that in which it has modified the same parts of the Didelphian Banded Ant-eater (*Myrmecobius*) of South Australia, and the Monodelphian Ant-eaters (*Myrmecophaga*) of South America.

These instances of Convergence could be greatly multiplied: but enough has been cited to make the reader aware that here, in Australia, there is, perhaps, the grandest manifestation of the biological truth that dissimilar stocks may be modified along similar lines by the demands of similar environmental needs, and that, therefore, rough similarity does not always necessarily denote kinship.

When the first white colonists came to Australia they were confronted by a fauna of which the members were, in a general way, reminiscent of the animal types with which they were familiar in their home lands. And yet, though a general similarity prevailed, there was the great difference, that the whole mode of reproduction, as typified in the pouch or marsupium, was unlike anything that was familiar in the animals they had left behind. It was this circumstance that led to the prefixing of the word "native," or in later times, "marsupial" or "pouched"

to the homely old world name for the animal. In this way we have inherited such names as " Native Cat," " Marsupial Mole," and " Pouched Mouse "—and it can only be said that this is an unsatisfactory scheme of nomenclature.

Familiar names become stereotyped by long usage, and it is to be hoped that in Australia good familiar names for the mammals will one day be forthcoming, and that they will become standardised before the indigenous mammals are extinct. But we must not forget that, even if a popular name is a thoroughly bad one, it is hopeless to attempt to replace it once it has become sufficiently familiar ; and no amount of book teaching will ever make the Australian forsake the incorrect name of " Opossum " for the alternative name of " Phalanger." In certain cases there are, however, very good native names for animals, and these terms should be conserved and used wherever possible. Very few people know the book name of " Banded Ant-eater " for the creature whose scientific name is *Myrmecobius fasciatus*, but it has already been provided with the native name of " Numbat," and if ever a familiar name is to be applied to this fast disappearing little animal, no better one could be found.

Again, the name Koala is a far better term for *Phascolarctus cinereus* than is the commonly used " Native Bear "—or the still worse and more recent " Teddy Bear."

There is one other general biological law that is well exemplified by the marsupial fauna of Australia, and this may be termed the Law of the Irreversibility of Evolution. This law is made more easy of understanding by studying an example of its working than by quoting a definition of its terms. Suppose a member of an arboreal stock to become modified by the demands of its environment to a saltatory cursorial mode of life, we know that it would be profoundly altered in the greater portion of its bodily structure. Suppose that, subsequent to this alteration of habit and change of form, circumstances again demanded that it should be a tree-climber, would it be able to alter itself back again and again appear as anything like a genuine arboreal animal ? It can alter its habit and environment, but it can never retrace its developmental steps. From being a specialised animal it may become secondarily specialised, or it may degenerate ; but it can never retrace its steps and become primitive. There are many reasons for believing that the marsupial stock was primitively arboreal and that its earliest members were predominantly tree-haunting creatures. At the present time several of the most primitive marsupials are true tree climbers. But we know that some, such as the Kangaroos, have become specialised as leaping animals which bound over open spaces. Certain members of this jumping stock have retaken to an arboreal life, and the curious Tree Kangaroos (*Dendrolagus*) of Queensland and New Guinea have carried out the experiment that we have just pictured. Now, although these animals show a considerable aptitude for an arboreal life, and demonstrate numerous re-adaptations to the business of tree climbing, they are not in the least like the typical primitive mammalian type of arboreal animal. Having become committed to a saltatory, cursorial, mode of life they adopted the structural modifications that are associated with that habit ; and these modifications prevent them from ever again becoming primitive arboreal animals, although in becoming arboreal, they are probably reverting to an ancestral mode of life. It will be seen from this brief survey of the general problems associated with the Australian mammalian fauna, that no better field of study could be offered to the naturalist and the observer. Every member of the fauna

is worthy of study for its own sake, and around the whole assemblage of species is woven a meshwork of the grandest and most important biological problems. In the Ornithodelphia and the Didelphia, Australia has a heritage for which it must accept responsibility; it must be prepared to conserve the living, to collect and preserve the dead, and to make provision for the proper study of the fauna in all its aspects.

Sub-Class I.—ORNITHODELPHIA.
MONOTREMATA or PROTOTHERIA.

At the present day the Ornithodelphia are restricted to the Papuan and Australian sub-regions; their range extending from New Guinea in the North to Tasmania in the South. Within this region, also, the remains of extinct forms have been found in comparatively recent geological deposits. These extinct forms are in almost every way similar to the main types now living, and they throw but little light upon the history of the sub-class.

Outside the limits of the Australian region the geological evidence of the past history of the Ornithodelphia is by no means clear. Forty years ago Professor Cope called attention to the resemblances which existed between the transient molar teeth of *Ornithorhynchus*, and those which characterise the somewhat heterogeneous group of Mesozoic animals known as the *Multituberculata*. Fragmentary remains of these animals have been found in the Triassic formations of England, the continent of Europe, South Africa, and North America. In most cases nothing, save fragments of lower jaws and odd teeth, has been preserved; the general characters of the whole skeleton being, for the most part, problematical, and merely deduced from a knowledge of the probabilities of correlation of animal structure. Even if we admit a similarity between the form of the molar teeth of the *Multituberculata* and those of *Ornithorhynchus*, we must remember that, in the case of the living animal, we are dealing with teeth which are in a very degenerate condition, and are, therefore, not necessarily typical of the dentition of the ancestral Ornithodelphian. It must also be remembered that the Mesozoic animals also possessed incisor teeth somewhat similar to those seen in the modern Wallabies and Kangaroos, and that such teeth are altogether wanting in the transitory dentition of *Ornithorhynchus*. The discovery of very fragmentary portions of the bones of the shoulder girdle of a North American member of the *Multituberculata*, known as *Camptomus*, makes the affinities of this group with the existing Ornithodelphia rather more probable; but, in the present unsatisfactory state of knowledge of the *Multituberculata*, it is unsafe to dogmatise as to their precise affinities with the existing highly specialised Monotremes of Australia.

Not more than half a dozen living species represent the Sub-class at the present day, and these species, though possessing the very primitive characters which distinguish their Order, are all very highly specialised animals in their own way. It is important to appreciate the specialised, yet primitive, condition of the living Ornithodelphians. It might, at first sight, appear that the terms specialised and primitive, when used to designate the same animal, were contradictory of one another; but in reality it is not so. There is no doubt that the Ornithodelphians constitute the most primitive group of the Mammalia; they are more like the members of the lower vertebrate Classes than are any other Mammals. But there

is equally no doubt that although *Echidna* and *Ornithorhynchus* belong to this very primitive stock, they are themselves very highly specialised animals. Each has become very wonderfully adapted to a rather restricted and highly specialised mode of life ; in this way we have very highly developed structural specialisations grafted on to a ground plan of basal mammalian simplicity.

The very primitive arrangement of the reproductive system of the Monotremes, which earned for them the name of Ornithodelphia (or animals having uteri like birds), naturally led those anatomists, into whose hands the newly discovered animals fell, to believe that some very curious facts concerning the reproductive habits awaited discovery. It did not even seem to be impossible that these very peculiar animals might, in fact, lay eggs as the lower vertebrates do. That the Monotremes were egg-laying animals was several times asserted, and by many naturalists it was believed in ; but some seventy years after the Platypus had first been made known to science, the egg-laying theory was largely discredited. For this curious state of affairs two main factors were responsible. In 1829 Dr. George Bennett first turned his attention to this subject. It is from him that the bulk of the book accounts of the adult animals have come, but he did not succeed in solving the secret of their reproduction. He had the advantage of the knowledge of the blacks whom he employed as hunters, and he devoted some thirty years to the quest, and collected a large number of animals ; but, in the end, he decided that the natives were mistaken when they asserted that the creature laid eggs. His work was published in 1860, and in 1868 Sir Richard Owen wrote, " the balance of evidence is still in favour of the young being brought forth alive." Bennett's failure to find the egg, and Owen's authoritative statement, persuaded most people to the belief that the Monotremes fell into line with the rest of the Mammals in producing living young. It was not until the year 1884 that the investigations of Mr. W. H. Caldwell, of Cambridge University, established the truth of the blackfellows' assertion, and forced the recognition of the egg-laying habits of the Monotremes upon the scientific world. On August 29th, 1884, Mr. Caldwell, who was working on the Burnett River, in Queensland, communicated his discovery that the Monotremes were oviparous to Professor Liversidge, of Sydney University. This message was, at Mr. Caldwell's request, forwarded to the British Association then meeting in Montreal. Caldwell's knowledge was derived from the dissection of a female *Ornithorhynchus* which had laid one egg, and had another fertilised and developing egg ready to be laid. This animal was shot and dissected on August 24th. Meanwhile, Mr. Wm. Haacke was investigating the same question in Adelaide, and on August 25th, in dissecting a female *Echidna*, he found a broken egg in the pouch. This specimen was reported, and exhibited at the meeting of the Royal Society of South Australia on September 2nd, 1884. Confirmation came next from Tasmania, for in October, 1888, Mr. Fletcher, of Campbell Town, in lifting an *Echidna* from its burrow, saw an egg drop from its pouch. The broken egg revealed an embryo, and both egg shell and embryo were preserved. Since 1888 our knowledge of the reproduction of the Ornithodelphia has been steadily increasing, and to-day all the essential facts, and most of the minute details of the process are well established. Within the last few years the patient investigations of Mr. H. Burrell have added a very great deal to the sum of knowledge of the habits and reproductive history of *Ornithorhynchus*.

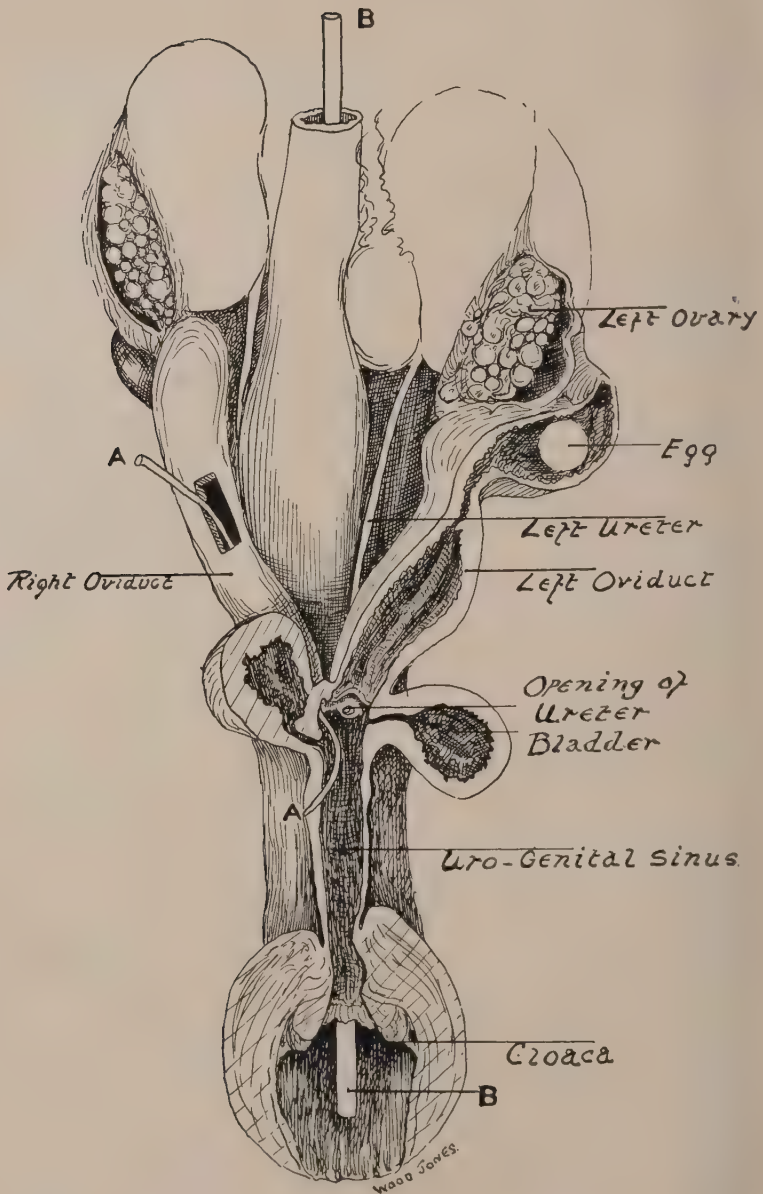


FIGURE 14.—Reproductive system of a female *Echidna* opened from the ventral surface. The bladder has been cut in half, in order to show the various openings of the ducts, etc. The bristle A is passed into a hole cut into the right oviduct and out of the opening into the uro-genital sinus. The rod B is passed through the intestine and out of the intestinal opening into the cloaca.

The two families which constitute the Ornithodelphia differ in certain details, but the main outlines of the general business of reproduction is similar in *Ornithorhynchus* and *Echidna*. In both animals fertilisation takes places in the ordinary mammalian way, and the fertilised egg passes down the oviduct. It is a strange fact that the eggs developed from the left ovary alone appear to undergo development, eggs being found only in the left oviduct. (*See* Figure 14). This curious unilateral development of maturing egg cells is not accompanied by any obvious unilateral development of the internal genital system, for the right ovary and right oviduct appear to be as well developed as the corresponding parts on the left side.

The monotreme egg is remarkable among mammalian egg cells for its relatively enormous size; for, although it is small when compared with the egg of a bird or a reptile, it is about thirty times as large as the egg cell of Man, or of any of the other higher Mammals. The diameter of the egg as it leaves the ovary is about six millimetres, and this relatively large size is due to the great store of yolk which the egg carries, a condition which in itself is reminiscent of the large yolked eggs of the lower vertebrates. As the fertilised egg passes down the oviduct it undergoes the preliminary stages of development; it increases in size and receives its covering of shell. The shell is largely composed of keratin, a substance which constitutes the leathery covering of the eggs of many of the reptiles and forms the organic basis of the chalky egg shells of some reptiles and all birds. The Monotreme egg is dirty white in colour and oval in shape, but the contour is by no means even, some eggs being actually dented and irregular in their outline.

In the case of *Ornithorhynchus* two eggs are usually laid at a time, but single eggs, and occasionally three eggs, are found in the nest. It is a curious fact that the two eggs are stuck together in their long axis; and so firm is their union that some considerable force is required to separate them. (*See* Figure 15). The two eggs probably adhere together before they are laid, but Mr. Burrell has noted the strange fact that the two eggs constituting a conjoined pair are usually not exactly the same size. The eggs are about seventeen millimetres long and thirteen millimetres broad when they are extruded from the mother's cloaca; and they are deposited in a nest which has been prepared at the end of a long tunnel in the bank of the watercourse or creek in which the animal lives. The eggs are brooded by the mother, and the temperature of the nest is maintained at about 65° F., but they are not received into a pouch for brooding, the ventral abdominal area in *Ornithorhynchus* never being developed into a deep enough depression to serve as an incubatorium. Within the nest the eggs hatch, and at the time of hatching the embryos measure from fifteen to twenty millimetres in length. The newly hatched young has but little outward likeness to the adult; it is in general rather pig-like, and the peculiar "beak" which is so characteristic of the species, is late in its appearance in the developing embryo. It obtains its nourishment by nuzzling among the fur of the mother's ventral abdominal surface.

FIGURE 15.—Two conjoined eggs of *Ornithorhynchus*. This is the commonest condition in which the eggs are found. Twice natural size.

Over this ventral " pouch area " are the openings of the milk ducts, and from these openings the milk is exuded, and is imbibed by the growing young animal. The young Platypus remains in the nest until it is covered with hair and is able to fend for itself. The eggs are laid about the middle of September.

Echidna lays only a single egg as a rule, and this egg is some fifteen millimetres in diameter. Within the egg, as it is laid, is an embryo which measures about five millimetres in total length. *Echidna* differs from *Ornithorhynchus* in that at the breeding season (which only occurs once a year) the ventral abdominal " pouch area " deepens, and becomes a functional incubatorium. Into this pouch the egg somehow finds its way. It has been suggested that the female can actually lay the egg into her own pouch by lying on her back and rolling into a ball. The process has not been witnessed, and can therefore only be regarded as an anatomical possibility. There are alternative suggestions. It is obvious that the egg has no power to effect its own translation from the cloaca to the pouch unless it rolls into it or is deliberately put therein. The hands and feet of *Echidna* would seem to be extremely clumsy instruments for transfering the egg, and it would appear to be very probable that the elongated muzzle of the mother is used for this purpose.

Soon after being received into the pouch the egg hatches, and an embryo of about twelve millimetres in length is produced. The naked embryo is a remarkable looking little creature, which evinces the greatest activity whilst still in the pouch; and it obtains its nourishment from the milk ducts which open within the incubatorium. The embryo remains in the pouch until it is about nine or ten centimetres long, at which stage it begins to grow its adult spines. For some time after leaving the pouch the young continues to obtain its nourishment from the mammary ducts which open into the pouch. A period of some ten weeks elapses between the time of impregnation and the period when the young animal quits the pouch. The breeding season appears to be about the middle of September.

In addition to the lowly organisation of the reproductive system there are other portions of the body which show marked differences from the type which prevails among the higher Mammalia. One good indication of the status that an animal occupies in the assemblage of living things is the degree of development to which the architecture of its brain has become carried. The Ornithodelphian brain, although in some of its features further advanced than are those of certain lowly Monodelphians, nevertheless, shows a condition of basal simplicity of organisation when we regard the system of bonds which unite the right and left sides, or hemispheres, of the brain. In the higher Mammals, great masses of nerve fibres, which pass between the most important centres in the two hemispheres of the brain, are gathered together in a dominant connecting bond, known as the *Corpus callosum*. In the Ornithodelphia this bond is absent. (*See* Figure 16.) The corpus callosum is a cerebral commissure, or a nerve fibre bundle, which keeps the higher centres of the right and left cerebral hemispheres in communication across the middle line of the brain. It cannot be said that the living Monotremes are deficient in the extent of their cerebral hemispheres—they are indeed mysteriously well endowed with cerebral cortex. But it may be asserted—borrowing an expression from the electrician—that their brains are underwired. (Compare Figures 16 and 17.) In the skeleton of the Ornithodelphia there are many evidences of the lowly linkages which the living members of the Sub-class retain. Only two conspicuous

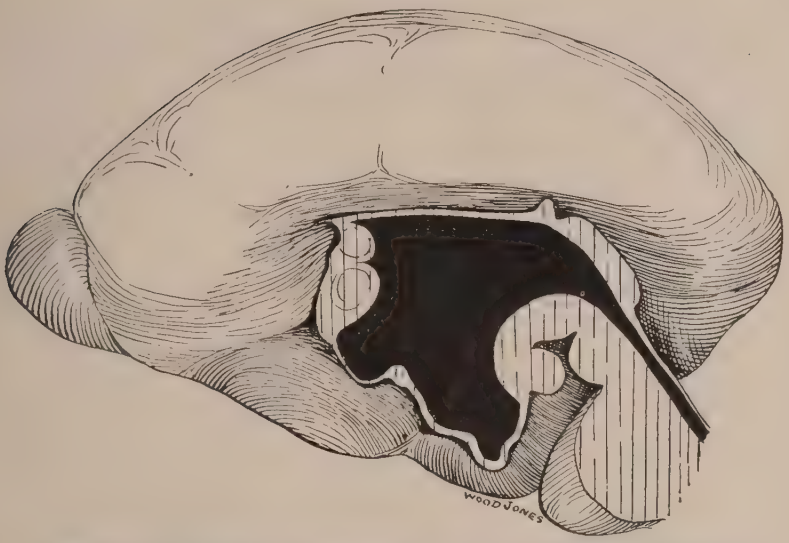


FIGURE 16.—The brain of *Ornithorhynchus*. The brain has been cut into a right and a left half and the figure shows the right half. The parts cut through in separating it from the left half are marked by vertical lines. The black portion is the central cavity of the brain.

FIGURE 17.—The brain of the domestic cat. This specimen has been prepared in the same way as that of *Ornithorhynchus* shown in Fig. 16. It will be noticed that in the cat a large structure (corpus callosum) has been cut through in severing the two halves of the brain. This structure is absent in the *Ornithorhynchus*.

osteological features need detain us here for explanation and illustration. A clear remnant of kinship with the lower vertebrates, such as the Reptiles, is shown in the arrangement, and relative development of the bones which keep the fore limb poised at the side of the body. In *Echidna* and in *Ornithorhynchus*, just as in the Reptiles, a bone, which takes part in making the socket for the arm at the shoulder joint, runs from the joint to the ventral mid-line of the body to join the breast-bone (sternum). This bone, which is named the *Coracoid*, keeps the shoulder joint fixed

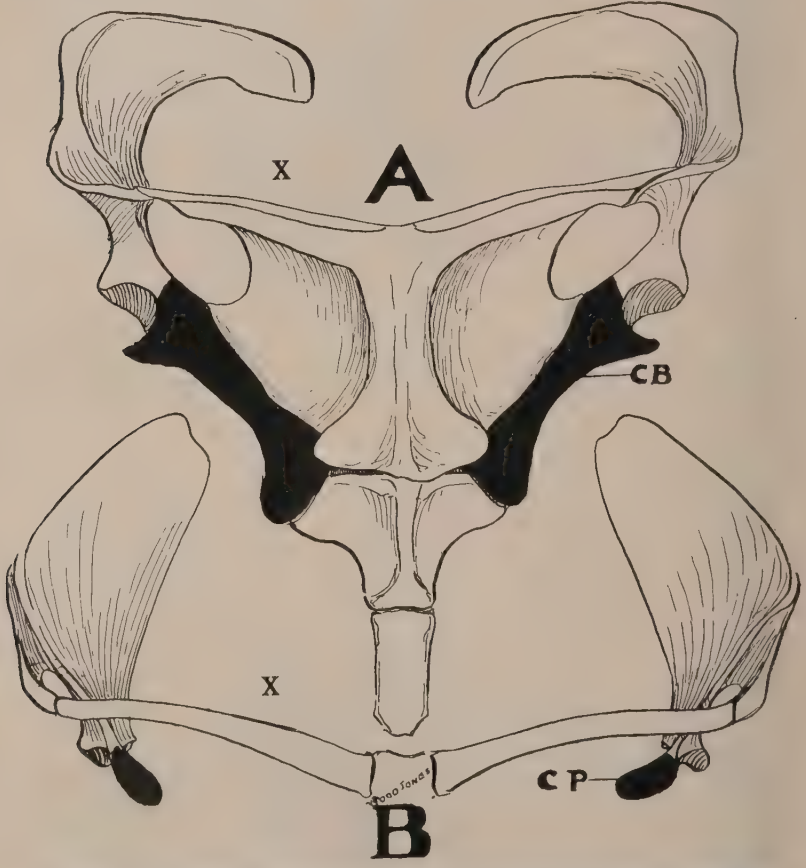


FIGURE 18.—A, The shoulder girdle of *Ornithorhynchus* contrasted with B, a diagramatic plan of the human shoulder girdle. The coracoid bone (CB) and the coracoid process (CP) are represented black. The clavicle is distinguished by X.

firmly to the rest of the skeleton. (*See* Figure 18, A.) But in all Mammals except the Ornithodelphia, the Coracoid bone has become reduced, and it does not come so far towards the middle line as to join the sternum. Then the shoulder is held to the rest of the skeleton only by the collar bone (Clavicle), marked X in Figure 18. When the Coracoid becomes reduced it turns into a mere knob on the shoulder, or blade bone (scapula), and it is then known as the Coracoid Process.

In Figure 18 the well developed coracoid bone of *Ornithorhynchus* has been contrasted with the comparatively insignificant process seen in Man. But it must not be thought from this that the human coracoid process is to be reckoned as a small one, when comparison is made with most other Mammals. The coracoid process of Man is far larger than the corresponding process in the kangaroo, for instance, though it is very small when compared with the fully developed bone of *Ornithorhynchus*.

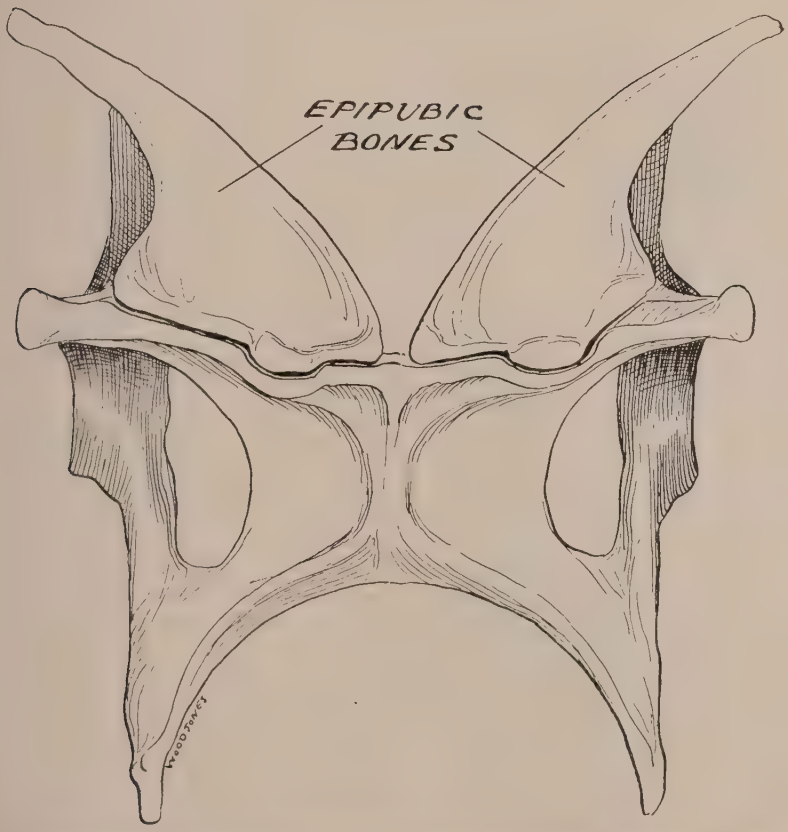


FIGURE 19.—The pelvis of *Ornithorhynchus* showing the epipubic or "marsupial" bones.

The completeness of the shoulder girdle is peculiar to the Ornithodelphia among Mammals; in the same Sub-class the bony support for the hind limb (pelvic girdle) also shows a very interesting peculiarity. Upon the cephalic end of the ventral surface of the pelvis are two large flat bones, only lightly joined to the other bones of the pelvis, and curving forwards and outwards from the middle line as two partial crescents. The bones are embedded in the muscles of the wall of the abdominal cavity, and are evidently structures developed in connection with the strengthening of the abdominal wall, rather than in connection with the support of the hind limb.

These bones are known as *Epipubic* bones, and they are present both in the Ornithodelphia and in the Didelphia. From the fact that they are most familiar in the skeletons of Marsupials, they are often wrongly known as the "marsupial" bones, but they are present in males as well as females; and in pouchless forms as well as in pouched species: those from the pouchless *Ornithorhynchus* are illustrated in Figure 19. They are not present, as developed elements, in the Monodelphia, but similar structures are found well developed in Reptiles.

The question of the poisonous properties of the Monotremes is one that has been many times discussed, and one that frequently claims attention in the columns of the newspapers. Widely differing opinions are entertained upon this subject, and these opinions are often held with a considerable amount of conviction. It will, therefore, be most profitable to avoid stating opinions, no matter how authoritative such opinions may be, and to limit this very brief account to the plain presentation of such well determined facts as are obtainable.

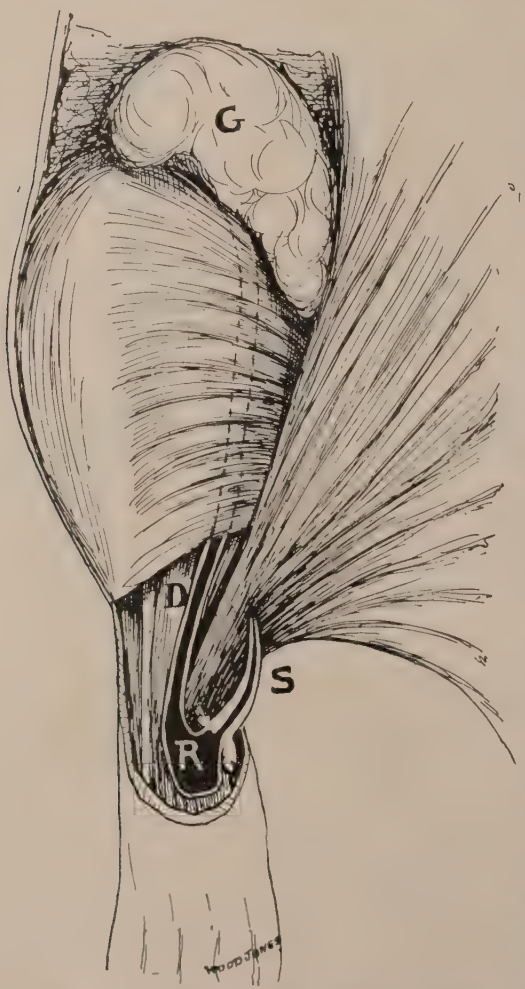


FIGURE 20.—Femoral or poison gland (G), duct (D), and spur (S) of a male *Ornithorhynchus*. The specimen is dissected from the dorsal aspect, and the gland of the left side is shown. R=the reservoir at the base of the spine.

In the first place the structures that are related to the supposedly venomous function have been repeatedly investigated and the naked-eye anatomy and the microscopic details of these structures are thoroughly well known. In *Ornithorhynchus*, a large, whitish, somewhat horseshoe shaped gland—named the Crural, Femoral or Poison gland—is situated at the dorsal aspect of the upper part of the hind limb. In size the gland is about 30 millimetres long, 20 millimetres wide, and about 15 millimetres thick. It is peculiar

to the male. The gland has the typical structure of a secreting gland, and the substance which it secretes passes from the gland, down a duct which runs along the back of the leg, and thence to the canal which runs through the hollow spur situated upon the inner side of the ankle. The normal condition is shown in Figure 20. The whole system is subject to seasonal variations in functional activity, and in relative development. In *Echidna* the system is not so well developed. The gland, which is situated lower down the leg, in the region of the back of the knee, is only about the size of a pea, and the spur is not so large or so formidable a weapon as that of the Platypus.

The secretion which is poured out from the gland in the Platypus, and which passes down the duct and to the hollow spur, and to any wound inflicted by the spur, is " practically a solution of proteids, chiefly albumin, but also proteose " (Martin and Tidswell).

So much for the anatomical condition of the system under discussion: we are dealing with well ascertained facts recorded by trained observers. When we come to inquire as to the use which the living animal makes of this system, we become sensible that there is less guarantee of accuracy in the range of observed facts dealing with function than we encountered when dealing with structure. Thoroughly reliable observations, however, carry us this far. The male *Ornithorhynchus* can, and at times does, strike with its spurs when handled. The spurs are capable of inflicting a wound, and this wound is followed by definite symptoms. The symptoms are somewhat akin to those present in cases of non-fatal snakebite, and men and dogs are equally affected when wounded by the spur. So far as I can ascertain, no recorded observations have ever given support to any of the various opinions that the apparatus has functions other than that of an offensive and defensive weapon. That the recorded observations show that the spur is not invariably made use of when the animal is handled, is of little moment.

When we pass further on, and inquire as to the effect of the secretion of the femoral gland when injected into animals, we again come into the realm of exact experiment and observation. Drs. Martin and Tidswell injected the secretion, in varying doses, into rabbits; and they found that it possessed a decidedly poisonous character. The rabbits showed, as minimum symptoms, local swelling and drowsiness, and as a maximum, death with convulsions within 90 seconds: the symptoms depending upon the dose and method of administering it.

We may say, therefore, that the male Monotreme possesses a secreting gland, a duct, and a hollow spur, as an anatomical entity. That the gland undergoes seasonal changes in activity, that its secretion, when injected into animals, is decidedly poisonous, and that its composition, and its effects, are probably akin to those of snake venom. That the symptoms, produced by the experimental injection of the secretion into animals, are similar to those described in well-authenticated cases of wounding of men, or dogs, by the spur of the living male Platypus.

Because we have limited ourselves to the statement of certain well ascertained facts concerning its use as a weapon, it must not be imagined that it is considered impossible that the animal may put the spur to other uses. The Monotremes are not easy animals to observe, and possibly many of their habits remain quite unknown for lack of proper opportunities for observation. But there is little to

be gained by mere speculation as to the function of structures found in living animals. Observation of the living creature is required. Speculation may be invoked if, unfortunately, the animal becomes extinct before the point has been determined by direct observation.

In many accounts of the relationships of the Monotremes to the rest of the Mammals, considerable stress is laid upon certain physiological factors in the economy of the living members of the Sub-class. Reptilian affinities have been argued not only from the fact of the secretion of poison from a gland, but also from the oft-repeated assertion that, to all intents and purposes, the Monotremes are cold-blooded animals, or animals which do not possess the power of maintaining a constant body temperature. Even though we may be free to admit that no function, save that of a poisonous one, has as yet been reasonably assigned to the femoral gland and calcaneal spur of the Monotreme, we have no need to suppose that in this function any physiological affinity with the venomous Reptiles is manifested.

In the same way we must admit that the body temperature of the Monotreme is unusually low ; but that is not to agree that they are akin to the Reptiles in failing to maintain their body temperatures within certain fairly definite limits.

The temperatures of seven females of the Platypus were taken by Mr. Burrell These females were removed from their nesting chambers, and the observations were made in September. The temperatures of these animals ranged between 30° C. and 33° C., and the average of all the observations was 32·2° C.

Of *Echidna* there are many temperature records, since it is an animal which is easily kept and examined in captivity. Miklouho-Maclay, in 1879, examined a series of "porcupines," and concluded that their temperature ranged between such low figures as from 26·95° C. and 28 3° C. In 1886, R. von Lendenfeld, as the result of a series of observations, concluded that the body temperature was higher but more variable, and gave the extremes as 28° C. and 35° C. Semon, in 1894, gave 26·5° C. to 34° C. as the range for *Echidna*. Sutherland, in 1897, found it to be as wide as from 22° C. to 36° C. Dr. C. J. Martin reinvestigated the question in 1902, and during the last few years Dr. Wardlow has made innumerable observations, and, thanks to his work, we may say that the peculiarities of the body temperature of the Monotremes are now well known.

The temperature of the higher Mammals varies within fairly wide limits, and in the different species that have been examined it ranges from about 36° C. upwards for a few degrees. It is therefore obvious that both *Ornithorhynchus*, with its average of 32·2° C., and *Echidna*, with its average of 31·1° C., are creatures of relatively low temperature ; but the difference between the Monotreme temperature and that of other Mammals is not nearly so great as it is often asserted to be. It must also be remembered that our knowledge of the temperatures of some of the lower Monodelphia is scanty, and it is possible that *Echidna* and *Ornithorhynchus* do not stand very far apart from some of the more sluggish and least advanced of the higher Mammals in the matter of their bodily heat. Again, the fact that the temperature of the Monotremes varies at different times of the day does not confer on them the distinction that some writers have imagined. Dr. Wardlow determined that the morning temperature was always lower than the afternoon temperature ; but the same is true of the higher Mammals and of man. Semon noted this varia-

tion in the temperature, but confessed that "a relation between these changes and the changing temperature of the outer air could, however, not be proved." That is to say, although the temperature of *Echidna* is variable its rise and fall does not correspond with the rise and fall of the temperature of its surroundings, as is the case with the lower Vertebrates. There is, nevertheless, a time when the temperature of *Echidna* does tend to follow the temperature of the outside air, and when the Monotreme can be said to behave somewhat like a "cold-blooded" or poikilothermic animal. This is during that period of the year when the animal undergoes a partial hybernation or aestivation. In the summer Dr. Wardlow's animals averaged 30° C. in the morning and 32·6° C. in the afternoon; but in the winter the morning temperature was 29·7° C. and the afternoon was 32·3° C.; but this fall in winter temperature is found in all hybernating or partially hybernating animals; and it can only be said that the Monotremes are animals having a rather low body temperature, but, nevertheless, being truly homiothermic (or "warm-blooded") within certain limits of temperature, and in the non-hybernating period. They have a typically good mammalian heat regulating mechanism effective between 27·6° C. and 32·6° C.; and it is only when the temperature is raised or lowered beyond these limits that the regulation tends to break down, and they behave as poikilothermic animals.

Having discussed some of the outstanding anatomical and physiological peculiarities of the Ornithodelphia, we are now in a position to define the Sub-Class and to inquire into the methods of classification of its representatives.

KEY TO THE SUB-CLASS.

Oviparous Mammals, having simple oviducts opening separately into a Cloaca. No external nipples are present. In the brain the Corpus Callosum is lacking. There is a T-shaped episternum. The Coracoid processes are prolonged to meet the sternum. The cervical vertebrae bear ribs. There are well developed Epipubic bones.

The animals falling within the Sub Class may be separated into two groups as follows:—

(A) Without teeth at any stage. With the muzzle elongated as a cylindrical snout. Feet not webbed. Hair mixed with sharp bristles.

Echidnidae.

(A[1]) With temporary teeth, afterwards replaced by horny plates. With the muzzle prolonged as a flattened beak. Feet webbed. Hair free from bristles. *Ornithorhynchidae.*

Family I.—ECHIDNIDAE.

Of the two Genera into which this Family is divided only one is represented in continental Australia.

(A) With the elongated muzzle straight and not greatly prolonged. Snout shorter than the head. ..... *Echidna.*

(A[1]) With the elongated muzzle greatly prolonged and curved downwards. Snout longer than the head ..... *Zaglossus.*

The Genus *Zaglossus* is confined to New Guinea, and does not concern us here. The Genus *Echidna* ranges from New Guinea to Tasmania.

Genus.—ECHIDNA (Georges Cuvier, 1798, Nom. Conserv.).

It is now generally admitted that the Genus *Echidna* contains but a single species. Within the very wide limits of its geographical range this species is subject to very considerable variation. Variation is shown in several directions—(1) The general body size ; (2) the proportion of spines to hair in the general body covering ; (3) the general color of the hair and spines ; and (4) the length and thickness of the spines themselves. The name of the single variable species is *Echidna aculeata* (Shaw, 1792), and the various geographical races are given additional sub-specific names.

The form which inhabits Australia as a whole (as distinct from New Guinea or Tasmania) is known as *Echidna aculeata typica* (Thomas, 1885) ; and a separate name, *Echidna aculeata multiaculeata*, was given by Rothschild in 1905, to the race inhabiting the extreme south of South Australia.

(1) Native Porcupine, Porcupine Ant-eater, Spiny Ant-eater, Australian Hedgehog.

Echidna aculeata typica (Thomas, 1885).

The region of the face is covered by brownish, flattened, bristle-like hairs, intermixed with finer cylindrical hair of a paler colour. A patch of cylindrical hairs is present around the opening of each ear. The site of the ear is somewhat variable in its appearance. As a rule, it is easily seen as an area where the spines on the side of the face show a parting, and reveal a hairy interval. The spines at this point are often disposed in a whorled manner, and the ear is apparent as a depression in the centre of the whorl. By a curious mistake the artist who depicted this animal in Krefft's "Mammals of Australia," placed the eye in this depression, and so imparted a very strange expression to the usually somewhat expressionless face of the *Echidna*. At times a true pinna, or auricle, is developed in some degree, and a little hairy tuft projects at the top and back of the orifice for the ear. The dorsal surface of the whole of the body is covered with flattened bristle-hairs intermixed with cylindrical spines. The degree to which the hairs are hidden by the spines, or project above the spines, is variable. The spines of the back are about 60 millimetres in their maximum length and, as a general rule, the larger the spine the lighter is its colour. Some of the largest spines are coloured pale straw yellow in the whole of their length, but the majority are tipped with black, which gradually fades to brown, and finally to yellow towards the base of the spine. The smaller

spines are brownish black throughout their length, but in all cases the base is paler than the tip. Upon the sides of the body the spines slope uniformly backwards towards the caudal end of the body; but upon the dorsal surface the spines are

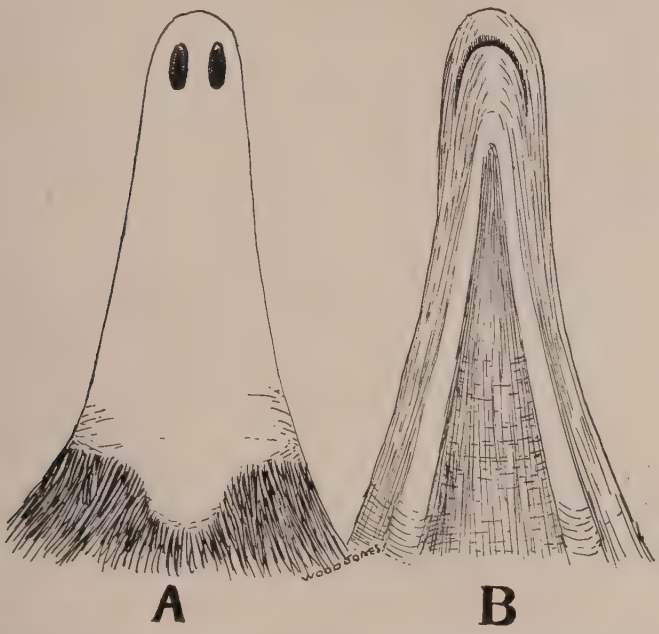


FIGURE 21.—The muzzle of *Echidna*. A, from above, showing the nostrils. B, from below, showing the mouth. From a female specimen. Twice natural size.

FIGURE 22.—Head of *Echidna*. Drawn from a female specimen. Natural size.

also directed towards the middle line. In the middle dorsal line a convergent track of spines is present; and the spines derived from the two sides of the body usually cross their points along the mid line in a very regular manner.

The limbs and the underside are free of spines and are clothed with coarse brown hair thickly intermixed with flat bristles. The actual tail is a mere stump, only about half an inch long, but the spines of the caudal extremity of the body stand erect in distinction to the spines of the general dorsal area and produce a conspicuous terminal tuft of spines, and this arrangement exaggerates the appearance of the tail.

The elongated and sensitive snout terminates in a bluntly rounded extremity. *See* Figure 21. There is a very slight tendency for the whole snout to be turned somewhat upwards at its tip. The nostrils are dorsal in position and are simple;

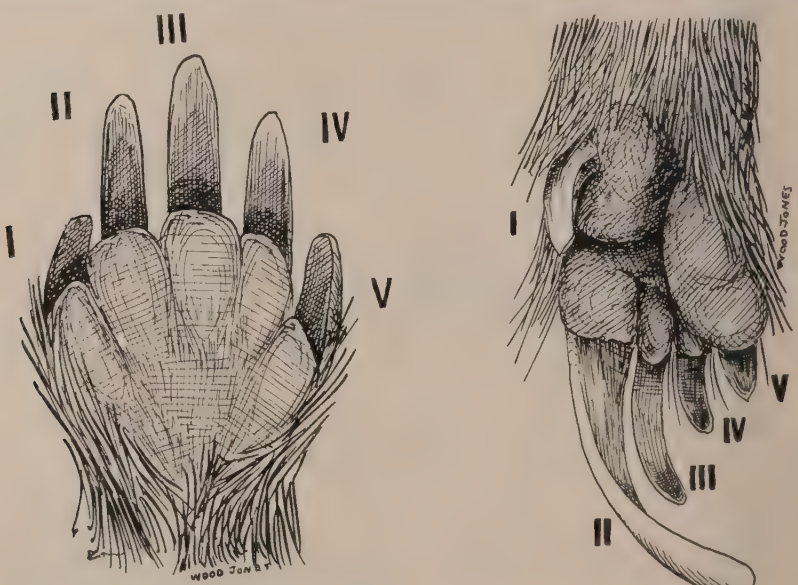


FIGURE 23.—The left manus and right pes of a female *Echidna*. Note the enlarged 2nd pedal digit, which is a specialised "toilet" digit. Natural size.

they are elongated in the long axis of the snout. The opening of the mouth is very small, and is sufficient only for the protrusion of the tongue. Dark eyelashes are developed upon both upper and lower eyelids. The pupil is circular, the iris dark-brown. There are no obvious "whiskers" or other sensory vibrissae upon the face, or upon any other part of the body. *See* Figure 22. The calcaneal spur is black in colour, and is partly concealed within a depression of the skin above the ankle.

In the manus the five strong digits are all armed with stout spatulate claws. The palm is naked, the skin simple. Pads are only poorly defined. The digital formula is $3 > 2 > 4 > 1 > 5$. *See* Figure 23. The integument of the manus is continued in a rather remarkable manner into the interdigital spaces, and when looked at from the dorsal surface the digging manus has a distinctly webbed appear-

ance. *See* Figure 24. The digits of the pes are considerably specialised, and the second, which is by far the largest, carries a greatly enlarged and curved claw. This remarkable claw is often regarded as a specialisation for digging; but it is a structure which belongs to a far more interesting category of adaptations of form to function. The spiny coat of the *Echidna* renders it difficult for the animal to cleanse its body by the common mammalian process of scratching, and it is for the purpose of reaching the skin of the body between the spines that this long curved claw is developed. The elongated claw and specialised character of the second pedal digit constitute a *toilet digit*, or a hair comb; and they are not specialised for the mere function of digging into the earth. The pedal digital formula is $2 > 3 > 4 > 5 > 1$.

FIGURE 24.—Right manus of *Echidna*, seen from its dorsal surface to show the pseudo-webbing of the claws. Natural size.

The animal varies a good deal in size, but apparently the two sexes do not differ markedly in their measurements. An average South Australian specimen gives the following figures:—

Length of head and body	400 mm.
Tip of snout to eye	50 mm.
Tip of snout to ear	85 mm.

(2) ECHIDNA ACULEATA MULTIACULEATA (Rothschild 1905).

This sub-species differs from the typical form in possessing more numerous longer, thinner, and paler spines. The spines are more finely tapering than are those of the common variety, and the hair of the head, legs, and underside is pale yellowish-brown.

The sub-species was described from the extreme south of South Australia, but it is to be noted that specimens from the extreme north of the State are also remarkable for the pale colour of their hair and spines.

Examples from Kangaroo Island are usually recognisable by their pale and abundant spines.

The *Echidna* is an animal which is extremely difficult to observe in its natural state, and accounts of its habits have, for the most part, to be taken from observations made upon captive animals. It is crepuscular or nocturnal in its activities, and obscure in all its ways of life. In captivity it readily becomes accustomed to feeding during daylight, but it reserves most of its activities for the darkness.

The animal is a burrower of the most remarkable kind, and its powers of clinging to, and sinking into the earth, can hardly be appreciated by those who have not witnessed the process. If an *Echidna* be placed upon a hard surface into which it is unable to burrow, it is capable of making off at a good pace, but the moment that it encounters ground into which it can dig, it ceases all attempts to escape

by shuffling along, and proceeds at once to sink directly downwards into the earth. In this process it does not burrow in head first, as do most burrowing animals; but it sinks in, in a way that can only be described as all-over-at-once. If it be interfered with in the preliminary stages of this process of digging itself in, it will be found that the animal appears to be miraculously stuck to the ground; and, once it has started to descend, it is almost impossible to arrest its progress and, draw it back.

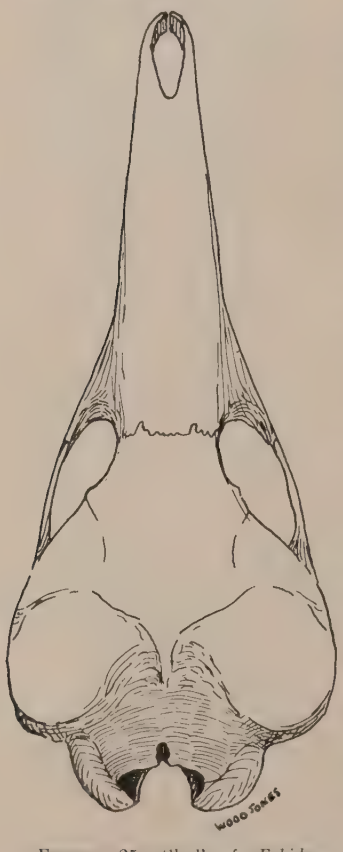


FIGURE 25.—Skull of *Echidna* viewed from above. Natural size. The specimen from an animal obtained at Mount Gambier.

Although these extraordinary powers of digging are commonly said to be the natural endowment of an animal which obtains its food by "digging up the ant or termites' nests with its powerful limbs," this time-honoured explanation is far from satisfactory. The digging of *Echidna* in its normal manifestation is certainly a protective mechanism; it is an elaborated method of avoiding its enemies, rather than a perfected means of obtaining its food. Even when it is quite unable to dig below the surface, it still shows its wonderful powers of clinging to the earth, for given any irregularities of surface of which it can take advantage, it will manage to wedge itself so securely, by the aid of its stout feet and its bristles, that it is practically impossible for an enemy to dislodge or even to injure it. In the same way it will wedge itself into the corner of its cage when confined; and an extension of the same process permits it to ascend the corner of its box in a manner rather surprising in an animal which has, apparently, so little adaptation to climbing activities. Its strength is very remarkable, and it is difficult to devise any cage in which it can be kept under observation, for its stout little limbs, and powerful claws, are capable of tearing a way through most materials.

Some idea of the strength of the animal may be gained from the experience of an Adelaide zoologist who put an *Echidna* in his kitchen for the night. Next morning all the furniture—the heavy dresser, the table, chairs, boxes, etc.—was found moved from the walls towards the middle of the room. The gas stove, which was fixed by its pipe, alone withstood the animal's efforts at removal.

Although so apparently dull an animal, it resents captivity acutely, and, in general, it may be said of captive specimens, that their whole energies are so thoroughly absorbed in attempting to regain their liberty, that the normal

behaviour of the creature is difficult to appreciate from observing animals kept in confinement.

In finding its way about, the sensitive snout obviously plays an important part, and everything is tested by being probed with the tapering end of the muzzle. In this testing it is not only the sensitive skin which is called into play, for, judging by the frequent inspiratory sniffs which form the accompaniment of most of its activities, the sense of smell is an important guiding factor.

Its vision does not appear to be at all acute ; and its range is apparently restricted to comparatively near objects. The sense of hearing, on the other hand, is evidently well developed, and the animal has an altogether extraordinary power of appreciating, either by auditory impressions, or by a tactile sense of vibrations, the advent of an approaching footfall.

Its only vocal accomplishment appears to consist in varying modulations, and amplifications, of the sniff through its nostrils.

Although the *Echidna* is often assumed to be solely a destroyer of " white ants " or termites, and is commonly depicted in the act of tearing into a termites' mound, it is, in South Australia at least, an animal which devours a variety of small insects. Doubtless in those parts of Australia where termites are extremely abundant the *Echidna* takes advantage of so vast a store of easily obtainable food, but true hymenopterous ants are the insects of which it takes the greatest toll in South Australia. The small black ants, known as " Sugar Ants," constitute the most abundant and the most usual contents of the intestines ; and, though other insects are found in varying quantities, there can be no doubt that *Campanotus nigrescens* is the staple article of diet.

In confinement *Echidna* will drink milk in most remarkable quantities. It will also eat bread and milk, finely chopped hard-boiled egg, or indeed any food substance which can be reduced to a suitable consistency. The gape of the jaws is so small that the mouth opens no further than to permit the long tongue being protruded and retracted at a rapid rate. Any animal substance which can adhere to the tongue, and be withdrawn with it into the mouth, appears to be appreciated by the " Porcupine," but it has a special liking for a raw egg with a hole made in it to admit the tongue.

It thrives well upon such a diet in captivity. Although so extremely fond of milk it appears to have little aptitude for drinking in the ordinary way. The nostrils are situated so near to the end of the snout that when it dips its nose into fluid they become immersed, and its drinking is interrupted with frequent snufflings as its nostrils become filled with fluid. It can survive for a very long while when deprived of fluid or of food ; its power of fasting being truly reptilian. It is said that it will easily exist for a month without any nourishment ; and this is doubtless true, for the animal normally undergoes a more or less complete hybernation.

Its power of recovering from severe wounds ; its tenacity of life ; and its extremely slow death, even when mortally stricken, are all reminiscent of the lower Vertebrates. It is usually said that *Echidna* prefers rocky, or sandy, country in which to dwell, but its distribution throughout the State shows that no one type of country can be said to be its elective or exclusive habitat. It has a remarkably wide distribution in South Australia, extending from the arid Centre to the coast and to Kangaroo Island. At the present time the " Porcupine " is in no immediate

danger of extermination. Fortunately for itself it is of no commercial value. It has no useful, or ornamental skin to attract the trapper, and since it has ceased to be a desirable article of diet for the aboriginal it is in the happy position of being practically useless to man. It does not in any way actively harm any human enterprise, and so it does not fall under the ban of the exterminator. Again, it has two other great assets—it is not attracted by the poison bait, and it is nearly fox-proof. Only the rabbit and the rabbit trapper are capable of appreciably interfering with the continuity of its archaic story. The burrowing rabbit, in all places in which it is abundant, causes a house shortage for other burrowers. The competition for breeding burrows is a very real factor, and it enters into the lives of some of the Marsupials even more acutely than it does in the case of *Echidna*. Again, the steel trap, intended for the rabbit, will often catch the unsuspecting Ant-eater. It is so obscure in its ways that its presence is not always suspected, and, although nowhere existing in great numbers, it retains a tenacious hold on a very wide area of country, in which, it is hoped, it will long remain unmolested

Family II.—ORNITHORHYNCHIDAE.

The Family contains only a single Genus.

Genus.—ORNITHORHYNCHUS (Blumenbach, 1800).

Despite the fact that, in the colour and texture of the fur, considerable variation is displayed by animals representing different localities, seasons, or periods of life, it is usually admitted that there is only one species of Ornithorhynchus.

The fact that the male and female are normally rather different in size, and coat condition is somewhat variable, has led to the description of several species, and at least half a dozen of these have, from time to time, received specific names. Here, however, all forms will be considered under the single specific title.

Platypus, Duckmole, Duckbill, or Watermole.

Ornithorhynchus anatinus (Shaw, 1799).

In general form the animal is strikingly flat ; the face, the head, the body, and the tail being flattened from above downwards. The whole bodily adaptation is obviously that of a surface swimmer.

The Platypus is clothed with a dense fur, which consists of a beautifully soft woolly underfur, concealed by a longer, harsher coat of shining hairs. The general colour of the dorsal surface of the head and body, and of the outer aspect of the limbs, is a deep umber brown, looking, of course, a great deal darker when the animal is wet. The ventral surface and the inner aspect of the limbs is slightly paler than the general body colour. There is said to be a " white or yellowish " area around each eye ; but this area, though almost always emphasised in text-book accounts of the animal, is not invariably present. Hair extends only just beyond the wrist upon the back of the manus ; but on the pes, hair is present right down to the extremities of the digits.

There are no sensory vibrissae or papillae upon the face or limbs. The naked skin of the flattened muzzle, or " beak," is of a suffused, purplish, slate-colour above, and

pale flesh-coloured, or mottled below ; and it is extremely delicate in texture. The dorsal surface is finely marked by minute pores, somewhat like those seen on the skin of the palm of the human hand. From the flattened dorsal portion of the beak a free fold of the same delicate naked skin is carried back over the anterior part of the fur-covered face. This fold forms a sort of shield, extending backwards almost as far as the eye, as shown in Figure 26.

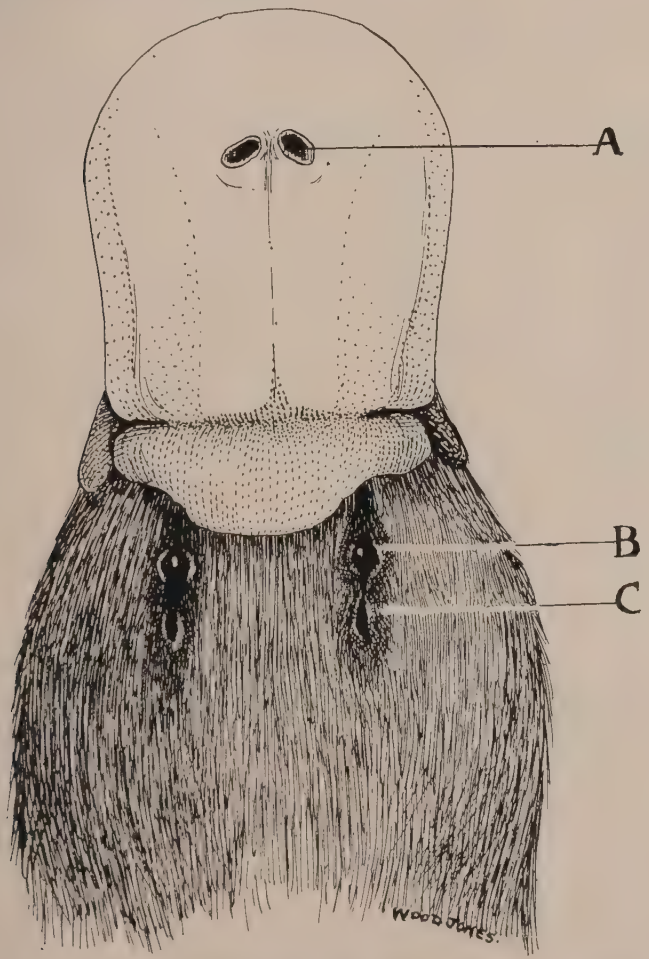


FIGURE 26.—Head of *Ornithorhynchus* seen from above. A, The nostrils, B, eyes, C, ears. Natural size.

The lower (or mandibular) portion of the muzzle is covered by skin similar in texture to that of the maxillary portion, but the little pores or pits are arranged more definitely in a linear series. From the lower jaw, as from the upper, a folded back portion, like the turned back cuff of a sleeve, overlaps the fur-covered throat. (*See* Figure 27.)

The tail, in conformity with all the other modifications of the animal, is flattened from above downwards, and it is slightly rounded at its free extremity. (*See* Figure 28.) Hair, coarse in texture, and of the same dark-brown colour as that covering the rest of the dorsal surface of the animal, clothes its upper surface. In young animals, hair, which is pale in colour, is also present on the under surface. In the adult, however, the lower surface is generally partly denuded of hair, doubtless by reason of the rubbing of the tail against the earth, as the animal trails it behind in the act of walking.

On general lines, the form of the tail resembles that seen in the Beaver; and this form is, in both animals, an adaptation to surface swimming and rapid diving. It has nothing whatever to do (either in the Platypus or the Beaver) with any

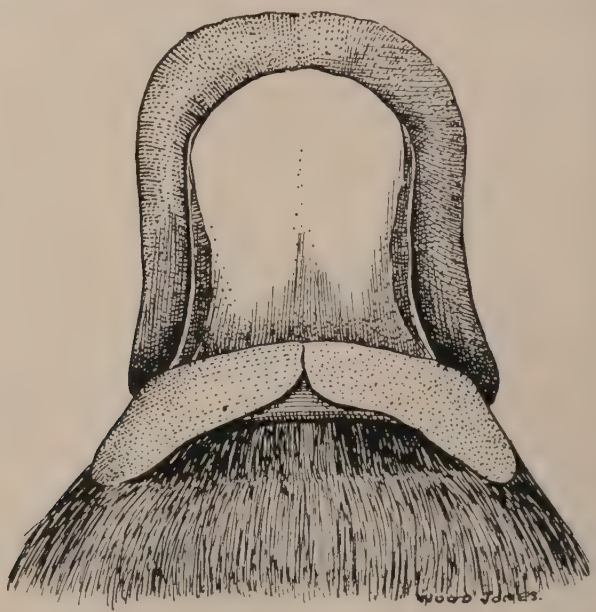


FIGURE 27.—The muzzle of *Ornithorhynchus* seen from below. Natural size.

supposed habit of puddling clay or flattening down the floor of its burrow or nesting chamber. When Beavers are alarmed they suddenly smack the water with their flat tails and dive beneath the surface. The loud sound made by the smack of the diving Beaver acts as a warning note to other Beavers in the neighborhood, and it is probable that the same warning note is produced by the Platypus. The animal has several times been described as making a sound as it dives.

The eye is very small, and is situated just behind the back-turned shield portion of the naked skin of the upper jaw. (*See* Figure 26.) An indistinctly specialised margin of the surrounding hair forms the eyelashes, which are not well specialised as such. The eye is situated in the anterior end of a furrow, which grooves the lateral and dorsal aspect of the face area in the young animal. In the posterior end of the furrow is situated the external opening of the ear. (*See* Figure 29.)

In the dried skin and the stuffed specimen too much of this furrow is apt to be alloted to the eye, and so in illustrations drawn from museum specimens the eye is often represented far too large. The eye is deeply situated. It is directed considerably more upwards than is usual in Mammals, even when they are adapted to an aquatic life. The iris is dark-brown, and in life the eye is said to be remarkably bright.

The opening for the ear occupies more of the facial furrow than does the eye. There is no sort of external ear or auricle projecting from the side of the head, but the orifice can be opened and shut at will in the living animal.

The nostrils are situated dorsally and close to the mid-line of the fore part of the muzzle. Their openings are oval in outline, with the long axis directed across the muzzle, but placed somewhat obliquely.

The calcaneal spur of the male is horn coloured, and recurved after the manner of the spur in a game cock. It is movable, and is directed backwards and inwards.

The powerfully built and webbed manus is a very remarkable structure, for the webbing does not consist in a mere membrane joining the adjacent digits together, but it is carried beyond the extremities of the nails by a series of leathery extensions which prolong the line of the digits. (*See* Figure 30.) This extension is capable of being folded back, so that the tips of the nails are exposed beyond the edge of the web. Strong nails are present on all five digits, and when the web is spread their tips are far outstripped by the free edge of the membrane. The typical digital formula is $4 > 3 > 2 > 5 > 1$.

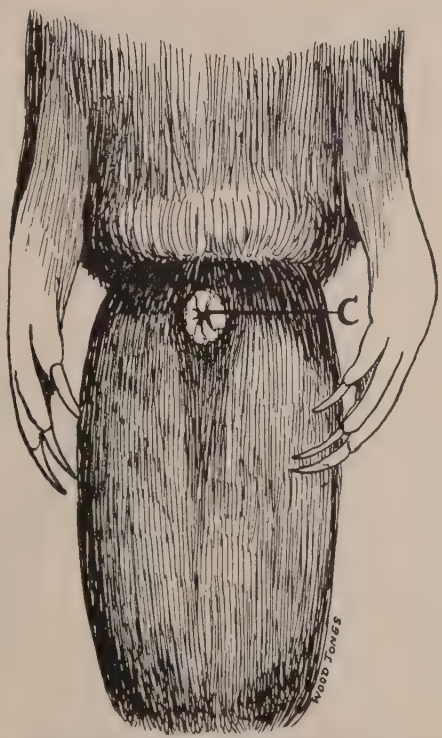


FIGURE 28.—Hind end of *Ornithorhynchus*, to show the tail and the opening of the cloaca (C). From the ventral aspect. Half natural size.

The pes is less highly specialised. Hair extends almost to the ends of the digits, and the webbing is not carried beyond the roots of the nails. Beneath the first digit a prolongation of the membrane, similar to that seen in the manus, is present. (*See* Figure 31.) The sharp nails are all curved with their points directed towards the fifth toe. The digital formula, when the toes are ranged in the axis of the limb, is $4 > 5 = 3 > 2 > 1$; but in the position in which the foot is habitually carried, all the toes are deflected from the axis of the limb.

It is well known that the Platypus starts its life with calcified teeth, and that these are subsequently replaced by the horny plates which subserve the function

of teeth in the adult and aged. The calcified teeth are very irregular and rudimentary structures. Those of the lower jaw, illustrated in Figure 32, show subdivision into three dental elements upon each side; but all three elements are fused together into a common calcified mass. This common dental mass, unlike true functional teeth, is extremely brittle in its composition. Upon each side of each jaw the dental mass is supported upon a flattened or slightly depressed area of bone.

At an earlier stage the three fused masses are separate rudimentary teeth; and at a later stage their site is taken by the horny plates, of which there are two in each side of each jaw.

The strange continuation of the jaws in the curiously flattened beak naturally leads to the formation of a very peculiar mouth cavity. Like all animals which have to take a large quantity of food into the mouth in a short time—and in this case because the gathering of food is done under water—cheek pouches are developed.

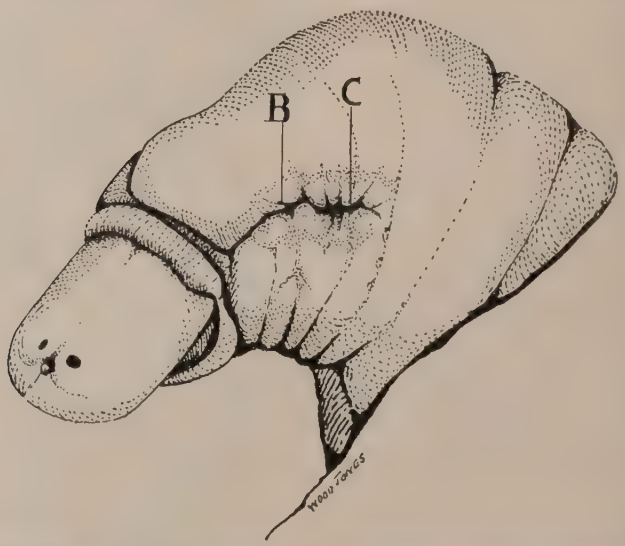


FIGURE 29.—Head of a naked nestling of *Ornithorhynchus*, to show the depression into which the eye and the ear open at B and C. Twice natural size.

The flattened fore part of the mouth, therefore, leads into two spacious pockets, into which the food is shovelled as the animal nuzzles about in the mud at the bottom of the creek. The curious structure of the margins of the lower jaw, and the form of the tongue, are shown at Figure 33, and it is somewhat important to realise the nature of this very curious structure, since it cannot be passed over when the question of the diet is under discussion.

There is a fairly well marked difference in the size of the male and female, the male always being the larger animal. The actual figures given by different authorities show a considerable range of variation, but it must be remembered that the skinned, or stuffed, specimen is always considerably stretched, and that,

in some cases, the larger records are probably made from such material. The specimen figured, which is a female from Victoria, is 485 mm. from the tip of the muzzle to the tip of the tail; the head and body measuring 365 mm. and the tail 120 mm. Other records are as follows:—

	Males. Total Length.	Females. Total Length.
Bennett, fresh specimens	475–500 mm.	.. 450–475 mm.
British Museum spirit specimens	563 mm.	.. 442 mm.
Ogilby	600 mm.	.. 475 mm.

Apparently before the fur of the Platypus was in much demand, and the animal had therefore not attracted to itself the undesirable attentions of the fur hunter, it was by no means strictly confined to darkness, or even dusk, for its main activities. Most of the earlier writers dwell upon the frequency with which it was seen floating upon the surface of the water in the early morning, or even during full daylight; and where it still remains wholly unmolested it evidently retains this diurnal activity.

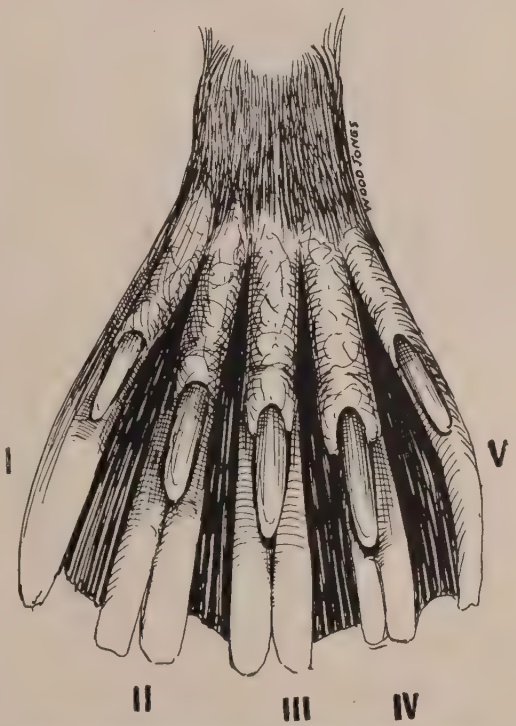


FIGURE 30.—Left manus of *Ornithorhynchus*. Seen from the dorsal surface. Natural size.

It is from the accounts of observations upon the living wild animal, and the records of his short-lived captives, by Dr. George Bennett that almost all the current literature of the habits of *Ornithorhynchus* is taken. These observations were made, over a series of years, nearly three generations ago. Between Dr. Bennett's time and the immediate present, there has been a long gap in the continuity of the story of our increasing knowledge of the natural history of the Platypus. Quite recently Mr. Burrell, by his observations upon wild animals, and on those he has succeeded in keeping in captivity, has added greatly to our knowledge of all the details of the economy of the animal. Many of these observations are incorporated here. Unlike *Echidna*, the obscurely living Platypus has not, until lately, been much studied whilst living in confinement, for the problem of keeping the animal in captivity successfully has only recently been solved.

The *Ornithorhynchus*, as its structure would lead us to suppose, is a thoroughly aquatic animal, swimming on the surface, diving, and paddling about the bottom of pools with wonderful facility. It is extremely shy, and the first white men who ever saw it noted the readiness with which it took alarm when approached. Its warning sense, be it visual, auditory, or tactile, is wonderfully acute, and when floating on the surface of the water it soon becomes aware of the presence of danger, and dives to safety below. What may be the actual sensory channels by which the Platypus is kept informed of its surroundings, is a point very difficult to determine. That the whole of the soft skin of the beak is a highly important sense organ, is quite definite. The minute structure of the tactile organs in the skin, and their connections with the nerves, tell us this; and so do the observations of Bennett—"if the mandibles were touched they darted away immediately, those parts appearing to be remarkably sensitive." Although the eye of the living animal is said to be brilliant, it is small and deep set, and so situated that its range of vision must be very limited. In any case, one would not expect the sense of vision to be remarkably acute in an animal which spends so much of its time in a dark burrow, or at the bottom of the water.

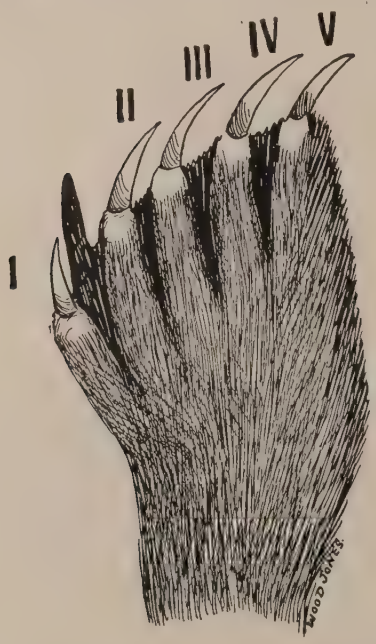


FIGURE 31.—Right pes of *Ornithorhynchus*. Seen from the dorsal surface. Natural size.

The sense of hearing is evidently very keen, and there is apparently some perception which enables the burrowing animal to recognise the proximity of another tunnel, and so to avoid breaking into it. A great deal more observation upon the living animal is necessary in order to determine the value of the several sensory channels; and, at present, it can only be confessed that it is impossible to determine what factor in the life of the animal can possibly have produced so comparatively large a brain. A brain, moreover, which, though built upon a lowly plan, possesses so great a share of specialised cerebral cortex, or grey matter.

The Platypus makes its home in the deep pools of rivers and creeks, preferring places where the banks are fairly steep, and where reeds border the edges of the stream. It is surprising how small a stream of water may be the home of quite a considerable colony. In the bank a nesting burrow, of somewhat variable form, is constructed. In length these burrows vary from 20ft. to 50ft., and they commonly run an erratic course into the bank. The burrow twists and turns about; but Mr. Burrell has made the interesting observation that, no matter how the tunnel may cross and recross its own track, the burrowing animal evidently knows when it is approaching a previously excavated portion. More than that, the animal

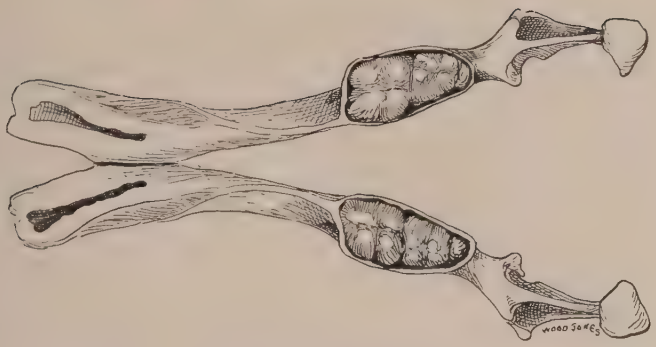


FIGURE 32.—The lower jaw of *Ornithorhynchus*. From a specimen in which the calcified teeth are still present. Natural size.

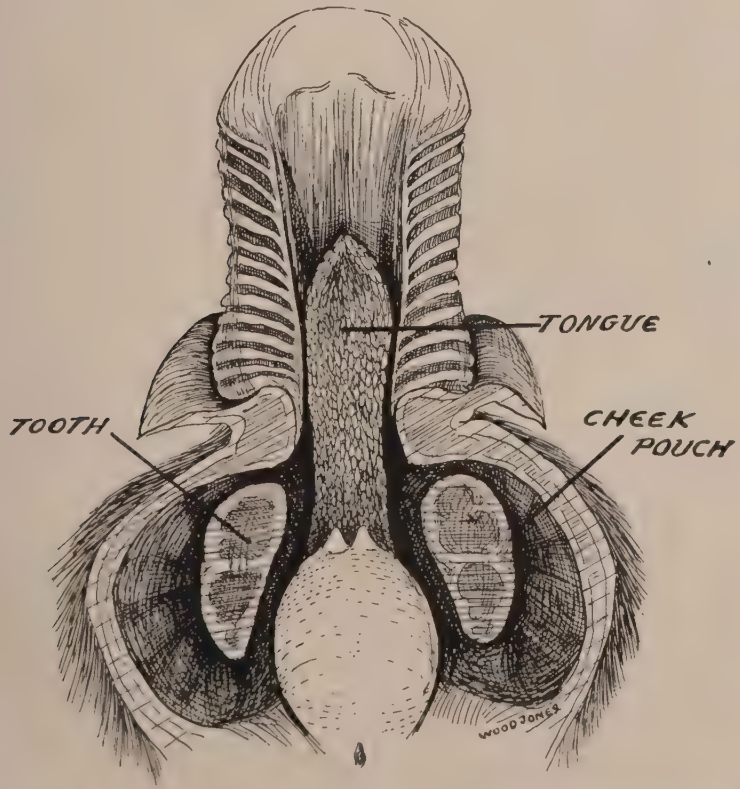


FIGURE 33. The lower jaw of *Ornithorhynchus*. The drawing is made from a specimen prepared by slicing off the lower jaw by cutting through the cheeks. It shows the peculiar structure of the lower jaw, the tongue and the teeth, which in this specimen are worn down and largely replaced by horny matter.

obviously avoids the already existing burrows of water rats, or rabbits ; for, when it is tunnelling in their vicinity, it alters its course in order to avoid them.

The entrance to the burrow is shaped like a low archway. It fits the form of the burrowing animal, and so is not rounded in outline like the burrows of the rabbit and the water rat. The nesting burrows are specially constructed by the females, and they contain, as a rule, numerous short, blind, side tracks, as well as a large oval nesting chamber in which a collection of leaves and dry grass constitutes the actual nest.

After the young are old enough to shift for themselves these nesting burrows are abandoned, and the shelter burrows used by non-nesting individuals are less elaborate in their construction. It is obviously important that an animal which spends so much of its time paddling in the water, or climbing in and out of an earth- lined burrow, should perform some rather elaborate toilet of its fur. Dr. Bennett noted that the first signs of ill-health in his captive specimens showed itself in the neglect of the toilet, and the consequent dirty and bedraggled appearance of the animal. He made frequent note of the care with which they cleaned themselves, and scratched and combed their fur, and wherever he describes how this process was actually carried out he writes of them " scratching themselves with the hind claws." He also notes the difficulties encountered by an animal which was tethered by one hind leg. The scratching is obviously an almost constant employment of the animal, and it is carried out studiously before it enters its burrow, as well as when it lies in its nest rolled up in a ball. Mr. Burrell has also witnessed the process, and describes the animal as squatting " tripod fashion on its haunches " and scratching with its " soft rubber-like hands." From the point of view of adaptations the pes would seem most fitted to be the main toilet member, but it is possible that both manus and pes are used in the toilet of the fur, as is the case with several of the Marsupials. Bennett also noted that the beak was used to preen the fur " as a duck would clean its feathers."

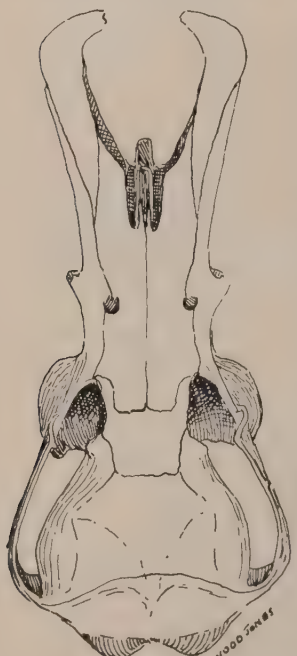


FIGURE 34.—Skull of *Ornithorhynchus*. Seen from above. Natural size.

Unlike *Echidna*, *Ornithorhynchus* is evidently a distinctly vocal animal. Bennett makes frequent reference to his captives growling when disturbed ; the growling was, however, no prelude to any offensive on the part of the animal. The same observer also noted that his young animals " uttered a squeaking noise," while of the adult pair he said, " they make a peculiar shrill whistling noise." In both cases the sound was made by one member of the pair, and was recognised and answered by the other.

In most accounts of the habits of the animal great stress is laid on shell fish as forming the basis of the diet, and Semon, in 1899, gave it as his opinion that "the principal food of this animal consisted of a hard-shelled mussel (*Corbicula nepeanensis*, Lesson)."

It has also been suggested that certain water plants are of importance as an article of diet. Bennett, however, never found any vegetable debris in the intestinal canals of the many animals he examined. On the other hand, he records a successful experiment of feeding captive specimens on fresh water mussels, but the mussels were broken up before they were given to the animals. These specimens lived 14 days, and died, in good condition, as the result of an accident. It is commonly said that the peculiar teeth and the curious jaw of *Ornithorhynchus* are developed in response to a diet of shellfish; but it is difficult to see any adaptation to such a diet in any part of the masticatory apparatus which is figured at Fig. 33. Bennett also records the successful feeding of the animal on worms, and includes in its dietry water insects and river shrimps. He fed his captives on bread soaked in water, chopped eggs, and minced meat; but such a diet was obviously not satisfactory, and he suggested that worms and fresh water crustacea would form a suitable diet. Judging from the formation of the parts connected with the ingestion of food, this suggestion is probably correct, and the common river shrimps may be regarded as the staple article of diet.

The Platypus at the present time is distinctly an eastern Australian and a Tasmanian animal, and Bennett did not believe that it existed in South Australia. Its inclusion in the fauna of South Australia is, however, quite correct even at the present day. From some of its old haunts it has disappeared. Nevertheless, it still occurs within the limits of our State, and from its unobtrusive habits it is possible that it may even linger in some places where its presence has escaped notice.

Sub-Class II.—**DIDELPHIA.**

MARSUPIALIA or METATHERIA.

Unlike the first Mammalian Sub-class (Monodelphia), the Didelphian division contains a varied assortment of animals of widely differing external type, and of numerous species. All these species are bound together by the possession of certain common features which have already been defined (pp. 16-18). These precise diagnostic features will be more fully explained here, and the general characteristics of the Sub-class will be discussed.

Dealing first with the external characters, it may be noticed that the hairy covering varies from the coarse hispid hair of the Short-nosed Bandicoots (*Isoodon*), and the Banded Ant-eater (*Myrmecobius*), to the woolly fur of the Koala (*Phascolarctus*), the silky hair of the Marsupial Mole (*Notoryctes*), and the wonderful chinchilla-like coat of the Rabbit Bandicoot (*Thalacomys*). The great majority of the marsupials are self-coloured, and if there be any variety in the colouration of a self-coloured animal it is usually displayed in the terminal portion of the tail. The tip of the tail may be darker than the coat colour (*Chaetocercus cristicauda*, *Phascogale penicillata*, etc., *see* Figs. 60 and 63), or paler than the coat colour (*Thalacomys lagotis*, *Pseudochirus peregrinus*, etc.).

When the coat displays a definite pattern, a very curious uniformity is seen throughout the whole of the Didelphia; for what may be termed loin banding, or a barred flank, is the predominant marking throughout the entire series. This loin banding is seen in such varied forms as the Tasmanian Tiger (*Thylacinus*), at times in the Tasmanian Devil (*Sarcophilus*), in the Banded Ant-eater (*Myrmecobius*), and in the Striped Bandicoots (*Perameles fasciata*, *P. gunni*, and *P. bougainvillei*), as well as in the Rabbit Bandicoot (*Thalacomys*). The same loin band again occurs in the Kangaroo Rats (*Aepyprymnus*), in the Hare Wallabies (*Lagostrophus*), and in numerous Wallabies and Kangaroos (*Onychogale*, *Petrogale*, and *Macropus*). Loin banding is probably a partial expression of the uniform body banding seen, for example, in such Monodelphia as the Zebras; but it is curious that, whereas in the Monodelphia a shoulder bar becomes the most permanent partial expression of the general body banding; in the Didelphia the loin band becomes the elected survival (*see* Figure 79). Another very curious feature of the banded flank is that it is by no means uncommon to have a unilateral slip in the pattern, and instead of a pale bar, followed by a dark bar, running as continuous bands around the girth of the animal's body, a pale bar on the one side becomes continuous with a dark bar upon the opposite side. This slip of pattern is often present in *Thylacinus*, and is not infrequent in *Myrmecobius*; it is also a well known phenomenon in the caudal banding of many of the Reptiles.

The coat pattern which ranks next in order of frequency to the loin banding, and which is often combined with it, is a dark stripe running from the snout through the region of the eye and cheek towards the ear. This cheek stripe is present in a very large number of marsupials of all classes. The other dominant constituent of coat pattern is a mid dorsal stripe, which is seen in several Opossums and Wallabies. Apart from the loin bars, the cheek stripe, and the dorsal stripe, there is the very irregular type of spotting, which is confined to the Native Cats (*Dasyurus*), and the curious piebald blotching seen only in the Cuscuses (*Phalanger*) of New Guinea and the neighbouring islands.

No Australian marsupial adds to the gaiety of its coat pattern by the display of naked and pigmented skin, which is so marked a feature of certain monodelphian groups; nor are any of them remarkable for the brilliant hues of their hairy covering.

Secondary sexual characters are, as a rule, by no means well marked. In most cases the male and the female are exactly alike. Among the carnivorous species, the female tends to be somewhat larger than the male; and in certain kangaroos the sexes are differentiated by coat colour; but no such secondary sexual distinctions are met with in the Didelphia as are commonly displayed among the Monodelphia.

The size to which any particular species of marsupial grows is subject to rather wide variation; and fully adult specimens of a species may vary considerably in their general proportions. This strange phenomenon is particularly marked in those species which inhabit the more arid regions of the Centre; and here it is probably related to the very varying nature of the country during good or bad seasons: the animals being larger when living through a succession of good seasons.

One curious feature which occurs with remarkable frequency among the Didelphia is the presence of fat tails; a condition in which the basal portion of the tail is

swollen or incrassated. This strange phenomenon is seen for example in *Phascogale macdonnellensis*, in *Chaetocercus cristicauda*, and in *Sminthopsis larapinta*, and *S. crassicaudata*, which latter is known as the Fat-tailed Pouched Mouse. (*See* Figure 68). The degree of thickening in the base of the tail differs somewhat remarkably in different individuals of the same species ; and it is possible that the accumulation of fat, and its subsequent diminution, is seasonal in its fluctuations.

The possession of an incrassated tail is no distinction of the marsupials however, for a monodelphian rat (*Conilurus pedunculatus*), discovered in the Centre by the Horn Expedition, and described by Waite, shows the same peculiarity. In this rat the thickening of the tail appears to be rather in the skin than in the sub-cutaneous tissues.

Moreover, there is a strange tendency for the same feature to appear among the Australian lizards. Of the Geckos we may notice *Nephrurus laevis* and *Gymnodactylus miliusii* as outstanding examples of fat-tailed reptiles ; and of the typical lizards the common Sleepy Lizard (*Trachysaurus rugosus*) shows the same condition.

In all probability the factor which produces this peculiar type of tail is a physiological one demanded by the conditions of life in the Australian environment. The base of the tail is probably a store house for fat laid up in a good season for use during those lean times to which all life is subjected in the more arid parts of the country.

Apart altogether from the condition of basal incrassation, in which the swollen portion tapers both towards the body and towards the tip of the tail ; there is a much more generalised phenomenon of a thickened tail base. This condition may best be described by saying that the body tapers more gradually to the tail than is usual, and the line of demarkation between the hind end of the body and the base of the tail is less sharply defined than in the higher Mammals. The state of affairs is easily realised by looking at pictures of a dog and of the dog-like *Thylacinus*. (*See* Figure 78). In the dog, the tail is a sharply differentiated appendage of the body, there is no doubt as to where the body ends and the tail begins ; but in *Thylacinus* the tail is the continuation of the body—it is the drawn-out hinder end of the animal.

Another curious point in connection with the same phenomenon is the fact that in very many marsupials the basal third or so of the tail is clothed by hair of the same colour and texture as that of the body, the specialised hairs of the tail only appearing some distance down the tail. This feature is conspicuous in *Phascogale penicillata* illustrated at Figure 60.

These two characteristics are obviously associated, and both are probably the expression of a very primitive state of affairs. The tail, in its primitive condition, is the elongated hind end of the body ; in its final mammalian state it is an appendage, which is put to various functional uses. To some it may seem absurd to liken the condition seen in the " Pouched Wolf " to that so familiar in the common lizards, but probably both are expressions of the same primitive phase of the caudal end of the body of the primitive land-living Vertebrates.

Another peculiarity of the tail is evinced in the readiness with which it becomes broken off and lost. The Pig-footed Bandicoot was originally named *ecaudatus*

under the belief that it had no tail, for the first specimen obtained was tailless; and in some places a Short-nosed Bandicoot (*Isoodon*) possessing a whole tail is a rarity.

It is of interest to note that many marsupials, in moments of heightened vitality, express some physiological state of well-being by a rapid vibration of the tail. The movement is expressed as a quiver which runs the length of the tail; it is altogether different from a shaking, or wagging of the tail; and it is exactly similar to the movement which may often be seen in the tail of a lizard about to seize some insect upon which its whole attention is focussed. This peculiar movement of the tail is very commonly seen when some of the highly carnivorous Pouched Mice (such as *Chaetocercus cristicauda*) are about to seize upon a victim, and the same thing may be witnessed any day when a kangaroo, in full contentment, is sitting in the sun.

Prehensile tails are carried to a high degree of perfection in the Ring-tailed Opossums (*Pseudochirus*), and are less well developed in many other arboreal types. Some of the Rat-kangaroos (*Bettongia*) possess the distinction of being the only thoroughly terrestrial animals which have typically prehensile tails. A dorsal crest of the tail is a feature which is present in some rather widely separated species; and a remarkable terminal spur, or "nail," occurs in certain Wallabies (*Onychogale*), as well as in the Rabbit Bandicoots (*Thalacomys*).

The ears of a great many species of marsupials are large, and are commonly capable of being folded when the animal is asleep. The method of folding differs widely in different species. The sensory vibrissae of the face, and of other parts of the body, are, as a rule, particularly well developed; and the actual condition present will be included in the description of the individual species.

As a general rule, it may be said that the Didelphia are but little gifted with the power of vocalisation. Compared with the Monodelphia they are a notably silent group of animals. Even such as possess loud or striking voices reserve the display of their vocal accomplishments for very definite and, maybe, for very infrequent occasions. It is a matter of common knowledge that the power of producing sound, and the capacity of appreciating it, are usually, and naturally, combined in any animal. We would not expect that an animal that could produce a wide range of vocal sounds would itself be unable to appreciate such a range of sounds.

A vocal animal we would expect to be one in whose life the sense of hearing played a well marked, if not indeed a dominant part. Conversely, it is likely that among animals which are predominantly silent, auditory impressions will probably be subordinate in importance to those of sight, or smell, or some other guiding sense. For the most part, the voices of marsupials are expressions of resentment, and are brought into play almost entirely during quarrels, or fights. Many marsupials, both carnivorous and herbivorous, are noisy in their internecine struggles for obtaining food, or mates; but the vegetarians, as a rule, possess the loudest voices, and indulge in the most noisy quarrels.

I believe it is true to say that no marsupial has a call, in the sense so familiar in the higher mammals, when one individual makes a definite vocal call to another individual. Among the Monodelphia the use of the voice as a call from individual to individual is a very wide-spread phenomenon, but if a call is used by any of the

Didelphia its use cannot be at all a frequent, or an easily recognisable, circumstance. We may note in connection with this that there are no pack-hunters among the Didelphia: no marsupials which combine for the purpose of obtaining food, or resisting enemies, or of gaining mutual protection during the breeding season. Probably the most efficient individual predatory carnivorous marsupial was exterminated by the pack-hunting methods of combination employed by the less efficiently armed dingo.

Most of the Didelphia are nocturnal, or crepuscular, in their activities; and the eyes of many species are adapted for vision in comparative darkness. In the Koala (*Phascolarctus*) the pupil is elongated vertically, but the typical didelphian pupil is circular. Eyelashes are, as a rule, well differentiated, reaching their maximum development in the wallabies and kangaroos.

The sense of smell is well developed in most forms, and is beyond doubt the dominant guiding sense in most of the terrestrial and carnivorous forms. Few marsupials possess any distinctive scent appreciable by man, and in no case is their natural odour offensive, as is that of the skunks and polecats among the Monodelphia. It is rather a remarkable fact that the Didelphia do not sweat; and in order to produce surface cooling most species lick their fur. The kangaroos and wallabies lick their arms; and many of the opossums, in the full heat of summer, moisten the greater part of their bodies with saliva.

No marsupial chews the cud, as do the Ruminants among the Monodelphia; but kangaroos and wallabies, as well as bandicoots, and probably some other forms have a curious habit of regurgitating their food. This regurgitation is no sign of ill-health, or of an unsuitable diet. The animal, after a meal, makes a vigorous heaving movement of its chest and abdomen, and the stomach contents, which are forced up into the mouth, appear to be re-swallowed without any further chewing.

The toilet of the coat is, as a rule, an elaborate business; and most marsupials are very particular in the matter of combing and cleansing the fur. In some animals the digits of the pes only are employed in scratching the fur; and in others, both manus and pes are used in toilet operations. The syndactylous condition of the pes is, in all probability, a structural adaptation to the function of performing the toilet of the coat. Further reference will be made to this singular modification in dealing with the section Syndactyla; and here we will be content with classing it as a functional adaptation, not a degeneration from disuse, or an instrument for use in climbing, but as a specialised toilet implement, analagous to the enlarged 2nd. pedal digit and claw already noted in *Echidna* (p. 43) The under fur of some of the marsupials is the haunt of certain curious ectoparasites known as *Mallophaga*. These *Mallophaga* constitute the Sub-Order of the Insects distinguished as the Biting-lice; several different species have been described from Syndactyla such as kangaroos, wallabies, rat kangaroos, wombats, and bandicoots; but they do not appear to be at all common in the coats of the Didactyla.

There is a remarkably uniform tendency running through the whole of the marsupials which expresses itself in the development of the lateral digits and the lateral side of the manus and pes. The middle line digit of the pentadactylous manus and pes is the third digit, and, in the Monodelphia, selection usually determines the dominance of this digit. The middle, or third, digit of our hands is longer than its fellows;

and in the horse it becomes the sole remaining member of the original five. In the Didelphia, however, the tendency for specialisation is to select the fourth instead of the third; the central axis of manus and pes being shifted outwards. The remarkably specialised foot of the kangaroo shows the dominance of the fourth digit to perfection; but the same phenomenon is demonstrated in varying degrees of development throughout the whole range of the marsupials.

The fact that so many marsupials are jumping, or saltatory, animals has given rise to many speculations by zoologists; and various explanations for the adoption of a jumping habit have been given. Sir Baldwin Spencer was much struck by the parallel (convergent) development of saltatory habits, and modifications, in the syndactylous kangaroos, the didactylous *Antechinomys*, and the monodelphian *Conilurus* of the arid open spaces of the Centre. He came to the conclusion that "possibly the real advantage in the saltatory method of progression amongst these small forms" (*Antechinomys* and *Conilurus*) "lies in the greater difficulty of pouncing down upon an animal travelling by leaps and bounds rather than in any advantage gained in the way of speed." He supposed that the birds of prey were the factor that had caused the evolution of this peculiar mode of progression. As a matter of fact, it is possible that some far more deeply seated biological factor underlies the development of a jumping habit. Open spaces call forth the development of animals which specialise in rapid movements; and we may say that, no matter what stock they may belong to, some animals which inhabit open spaces will develop a rapid gait, and they will either become cursorial (running), or saltatory (jumping). Now the essential difference between these two gaits is this. In the cursorial method of developing a rapid gait the two hind legs are brought into use alternately; in the saltatory method they are brought into use simultaneously. In the perfected saltatory method of progression the fore limbs are altogether dispensed with as a means of propulsion, and the simultaneous use of the hind limbs is alone relied on.

A kangaroo in slow progression uses its fore feet alternately, and its hind feet simultaneously, and it is a saltatory animal because, when rapidly moving, it lifts its fore feet from the ground, and resorts altogether to the use of its simultaneously acting hind limbs. But a bandicoot also always advances its fore limbs alternately, and its hind limbs simultaneously, in slow progression; but it is not a saltatory animal, for when in full gait it still makes use of its fore limbs in progression, although it uses them simultaneously. The bandicoots, in any gait, seem to have no power to use the hind limbs alternately. They cannot run after the manner of a cursorial animal. They are not saltatory, but apparently they show the physiological basis of a saltatory evolution. A saltatory animal may be said to be one which acquires an aptitude for speed when its motor nervous system demands the performance of simultaneous movements of the hind limbs. A cursorial animal, on the other hand, develops the ability for rapid movement in the presence of alternately moving hind limbs.

Certain anatomical characters of the marsupials need mention, and first it is convenient to notice some of the peculiarities of the skeleton. The marsupial skull is distinguished, as a rule, by the smallness of the portion which lodges the brain, and the large size of the part immediately in front of the cranial cavity, which

accommodates the chambers of the nose. Such an osteological condition we should be prepared to meet from a consideration of the importance of the sense of smell in most marsupials, coupled with the relatively low development of their intelligence. Until direct contrast is made between comparable skulls of Didelphia and Monodelphia, the disproportion between the cranial and the facial or nasal portions of the skull is often not appreciated.

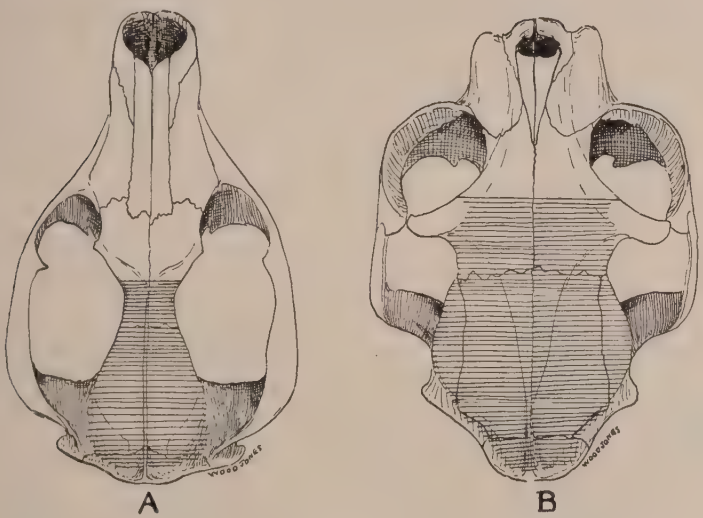


FIGURE 35.—The skulls of A. a Tiger Cat (*Dasyurus*), and B. a Domestic Cat of exactly the same length. The part of the skull which lodges the brain is marked by transverse lines in both cases. Two-thirds natural size.

Figure 35 shows the skulls of the didelphian Tiger Cat (*Dasyurus*) and the monodelphian Domestic Cat. The skulls figured are of exactly the same length. The *Dasyurus* skull shows a series of very perfect adaptations to the end of seizing and killing prey, and to this end it is better equipped than is the Domestic Cat; but as a brain case, in which is stored the organ of the animal's intelligence, the skull of the *Dasyurus* falls very short of the standard of the monodelphian cat. The contrast between these two skulls is a very remarkable one, and the triumph of the intelligent killer over the killing machine is being witnessed all over Australia where didelphian and monodelphian meet.

A very common character of the marsupial skull is the presence of gaps in the bones which form the roof of the mouth. These gaps are known as *palatal vacuities*, and they are so frequently developed as almost to constitute a peculiarity of didelphian osteology. They may be single, double, or multiple; and they may occur at differing sites in the palate. In Figure 36 the very large median gap in the palate of *Thalacomys* is illustrated. The smaller holes seen in the palate, behind the main gap, are those which are enlarged to make the perforations in the palates of many of the kangaroos and wallabies (*see also* Fig. 7). In most cases, the holes increase in size with the age of the animal; and in the kangaroos and wallabies

the palate is complete in the young animal, and the perforations only appear when it has cut the majority of its teeth. In certain forms, the palate is complete throughout life. Figure 37 shows the palate of *Myrmecobius*, and in this strangely primitive didelphian type the palate is not only imperforate throughout life, but it is of remarkable extent.

The form of the didelphian lower jaw is a matter of some importance, since, by a chance which is not very easy to account for, the lower jaw alone is so commonly preserved in a fossilised condition, when all the other portions of the skeleton of

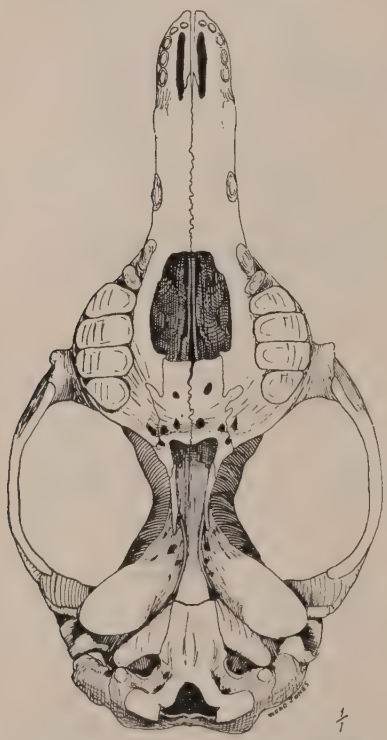


FIGURE 36.—Skull of the Rabbit Bandicoot (*Thalacomys*), drawn from below to show the large gap in the bones forming the palate. Natural size.

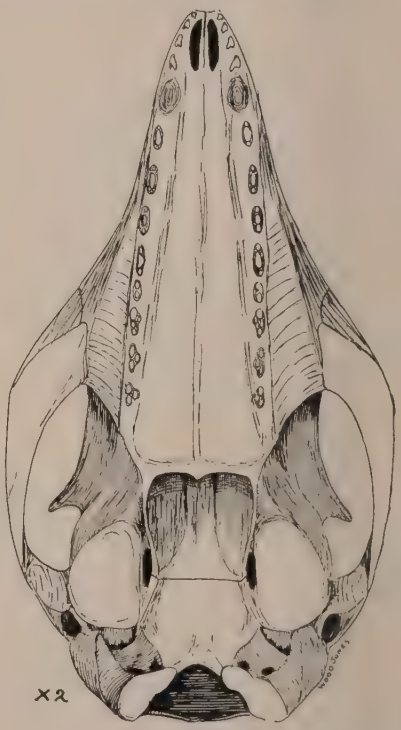


FIGURE 37.—Skull of the Banded Ant-eater (*Myrmecobius*), drawn from below to show the very extensive and complete palate. Twice natural size.

a long extinct animal are lost for ever. It is characteristic of the lower jaw of the existing marsupials that, at the back of the jaw, the lower edge of the bone is bent inwards. This condition is known as inflexion of the angle of the lower jaw; and it is noteworthy that it was the detection of this character, in the fossilised jaws of the oolite formations of Stonesfield, that first caused the great comparative anatomist Cuvier to declare that not only were these jaws mammalian (a view which was opposed by his compatriot De Blainville), but that they belonged to extinct marsupials.

The degree of inbending is but little marked in *Myrmecobius*, but in most species it is very pronounced. The condition is illustrated from the jaw of the Tasmanian Pouched Wolf, which in this respect shows a marked contrast when compared with the, otherwise very similar, jaw of a dog. (*See* Figure 38).

The separate bones (vertebrae), which compose the backbone in the neck, the back, and the loins, show a great constancy in their number in the marsupials. In all species (as in all typical mammals) there are seven bones in the neck (cervical vertebrae), and in all species there are nineteen in the chest and abdomen (dorso-lumbar vertebrae). In most marsupials thirteen of these dorso-lumbar vertebrae bear ribs (dorsal or thoracic vertebrae), and six are ribless (lumbar vertebrae). The typical marsupial, therefore, has seven joints in the neck, thirteen joints and thirteen ribs in the chest, six joints in the loins, and an indefinite number of joints in the tail.

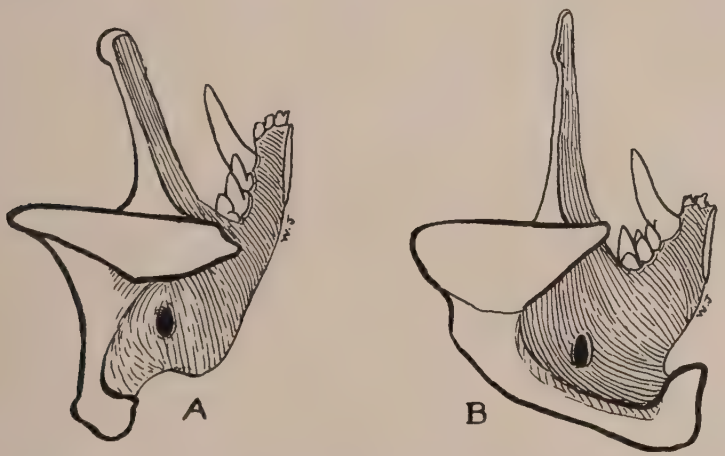


FIGURE 38.—The left halves of the lower jaws of A. a Dingo, and B. a Tasmanian Pouched Wolf (*Thylacinus*). The jaws are seen directly from the back so as to show the manner in which the marsupial lower jaw is bent inwards at its posterior end.

As a marked distinction from the Ornithodelphia, the Didelphia show an universal reduction of the coracoid bone, which element in most species becomes reduced to an inconspicuous knob on the shoulder bone (scapula). In the bandicoots the clavicles also are absent, as they are in many of the Monodelphia, but in all other Didelphia they are present, and usually they are well developed. The clavicles are bones the development of which depends upon function, and the limited nature of the movements of the fore limb in the bandicoots accounts for their failure to develop.

In most Didelphia, but not in all, the lower end of the arm bone (humerus) is traversed, upon its inner side, by a wide hole. This hole, which is known as the *epicondylar foramen*, is a feature which reappears in many of the Monodelphia, and is occasionally present in Man. The epicondylar foramen of the kangaroo is shown in Figure 39.

The nature of the epipubic, or so-called "marsupial," bones has been already discussed in dealing with the Ornithodelphia (p. 35). These bones are present in all marsupials, with the exception of the Tasmanian Pouched Wolf (*Thylacinus*): in this animal they are represented only by small unossified pieces of fibro-cartilage. In the kangaroos they are relatively small, but are well ossified. (*See* Figure 40).

The knee cap, knee pan, or patella is not developed in most

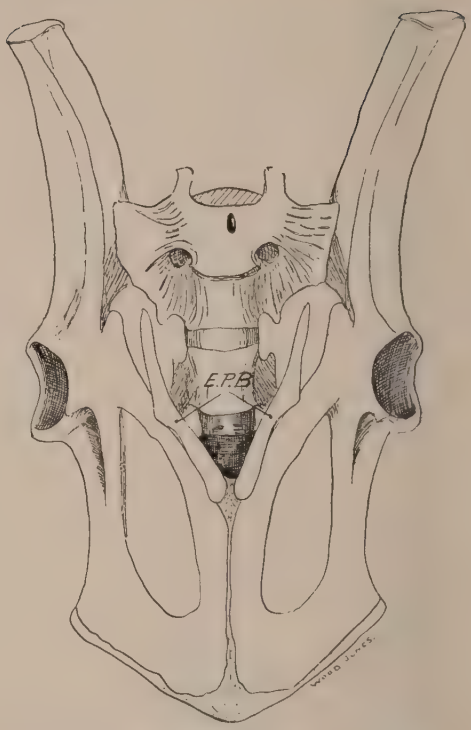


FIGURE 40.—The pelvis of a kangaroo to show the "marsupial" or epipubic bones marked E.P.B.

FIGURE 39.—Right humerus of a kangaroo. The arrow passes through the epicondylar foramen.

of the marsupials. In the bandicoots alone is there a well developed and ossified patella. In all the rest of the Didelphia there is merely a thickening of the tendon of the muscles of the front of the thigh as this tendon passes over the knee joint. This thickening may be merely a development of fibrous tissue, or it may be cartilaginous, or it may contain a few irregular little masses of bone.

The Didelphia, like the Monodelphia, possess well developed, and functionally specialised teeth. The range of diet open to the marsupials is as wide as that available for the higher mammals; and, as a natural result, both Monodelphia and Didelphia show all phases of the modification of their dentitions into definite types for the purpose of eating grass, browsing on herbage, catching, killing, and biting up insects, killing and tearing other animals, and for dealing with those more varied fares known as mixed diets.

There are typical herbivorous and typical carnivorous marsupial dentitions, just as there are grass-eating and flesh-eating dentitions among the higher animals. The dentitions of carnivorous and herbivorous marsupials are markedly different from each other, and the whole of the Order may be divided into two Sub-orders by reference to the prevailing type of dentition. In the carnivorous marsupials, as in the carnivorous Monodelphia, there is a tendency to retain an ample series of small front teeth; whereas, in the herbivorous section, the front teeth are reduced in number but increased in size. The marsupials with the carnivorous type of dentition are therefore termed *polyprotodontia*, and those with the herbivorous type *diprotodontia*; but, as we shall see later, such a classification by dietry is hardly likely to express the true genetic affinities of the animals concerned.

Although the dentition of, say, an insect-eating didelphian will show considerable general convergent resemblance to that of an insect-eating monodelphian, and individual teeth may become strikingly similar; nevertheless the didelphian peculiarities are always noteworthy. In the first place, the teeth of the Didelphia tend to be numerous, and the Banded Ant-eater (*Myrmecobius*) has the distinction of possessing no less than 56 teeth in some instances. Again, no marsupial is distinguished as a toothless or edentulous animal, as are certain of the Monodelphia.

The second peculiarity is that although there are 7 cheek-teeth on each side of each jaw in both Didelphia and Monodelphia, 4 of these teeth are molars, and 3 are premolars in the marsupials; whereas, in the Monodelphia, only 3 molars are developed, the remaining 4 cheek-teeth being premolars. The possession of a fourth molar tooth constitutes a well-marked didelphian peculiarity.

The typical, or ideal dentition of the Didelphia may be summed up in a dental formula written as follows:—I. $\frac{5-5}{4-4}$; C. $\frac{1-1}{1-1}$; PM. $\frac{3-3}{3-3}$; M. $\frac{4-4}{4-4} = 50$.

It must be understood that the typical marsupial formula is an ideal one, from which individual species vary in one direction or another; some have more teeth some have less: and the total may be as few as 22 in the little *Tarsipes* of Western Australia, or as many as 52 or even 56 in *Myrmecobius*.

It is a remarkable fact that, with the single exception of the Wombat, no marsupial has the same number of incisor teeth in the upper and lower jaws. The Wombat has two upper and two lower incisors; but in all other marsupials the upper incisors exceed the lower incisors in number.

The next dental distinction of the marsupials concerns the succession of their teeth. In Man, as in the majority of monodelphian mammals, there are two sets of functional teeth; a set of temporary or deciduous teeth, which is shed as age advances, and is replaced by a set of permanent teeth. In some marsupials, only one set of developed teeth is present throughout the whole of the animal's life; and in no marsupial is more than one tooth upon each side of each jaw replaced by a succeeding tooth when it is shed. We may, therefore, say that there is only one functional member of a deciduous set of teeth developed in the Didelphia. This single tooth is a molar. The replacing tooth is always the hindmost of the premolars, and it replaces the most anterior member of the molar series. This limited succession, or absence of succession, is typical of all marsupials; but in some forms, especially in the kangaroos, there is, combined with the replacement

of the single tooth, a curious shifting of the whole line of the cheek-teeth towards the front of the jaw. The succession, and shifting, make the determination of age, and the diagnosis of the actual teeth present in the jaws, matters of considerable uncertainty. In all accounts of the actual state of the teeth in any of the kangaroos or wallabies great caution is needed in assigning names to the individual teeth. These curious changes may be readily followed by reference to the diagrams (Figures 41-42) drawn from actual stages seen in a series of skulls of the Kangaroo Island Wallaby (*Thylogale eugenii*). In the young animal represented at Figure 41A five

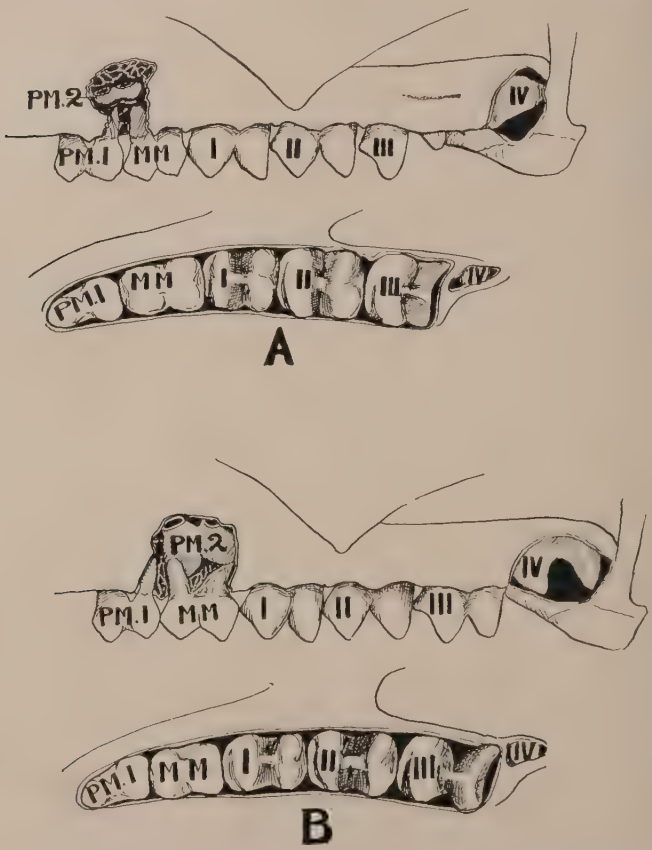


FIGURE 41.—Successive stages in the eruption of the teeth in a wallaby (*Thylogale eugenii*).

cheek teeth are present. These are, from before backwards, the 1st premolar (PM. 1), the temporary molar (MM), and the 1st, 2nd, and 3rd permanent molars (I., II., & III.). If the bone of the upper jaw be cut away above the temporary molar, the germ of another tooth, the last premolar (PM. 2), will be found developing; and, in the same way, behind the 3rd permanent molar, the germ of the 4th (IV.) will be found buried in the jaw. In the animal represented in the same

figure at B, the same teeth are present in the jaw, but the buried and developing teeth have increased in size.

In the stage shown in Figure 42C, the temporary molar has been shed, and the second premolar has been cut so as to take its place. There are still five cheek-teeth present in the jaw, but they are not the same five as were present in stage A.

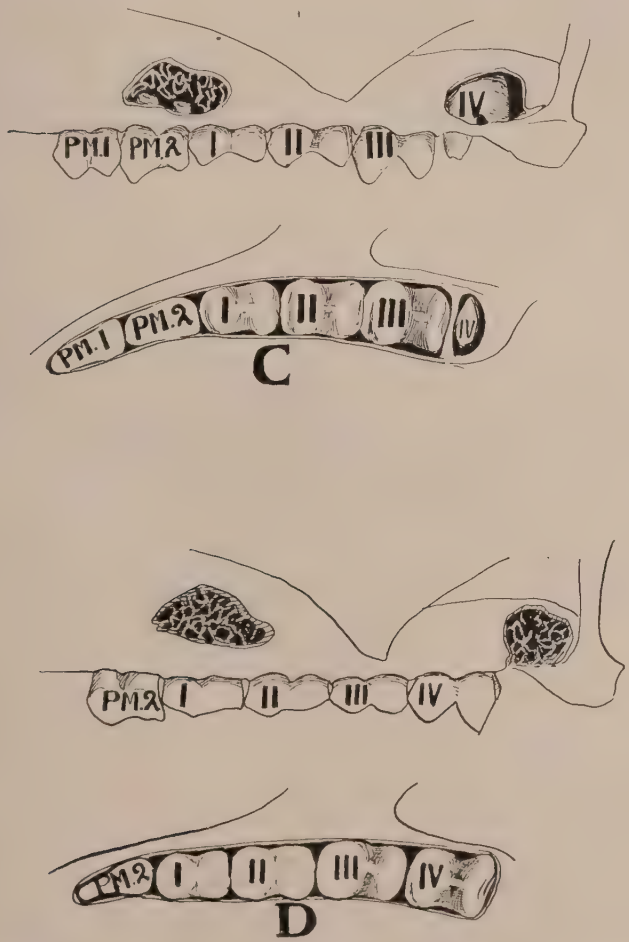


FIGURE 42.—Further stages in the eruption of the teeth in a wallaby (*Thyogale eugenii*).

In D, which represents a still older animal, another series of changes has taken place. First, the anterior premolar has been shed, and the 4th permanent molar has been erupted—there are still five cheek-teeth in the jaw, but these five are not the same as those in A or in C. Nevertheless, the resemblance between stages A

and D is made remarkably close, since the whole line of 5 teeth has shifted forwards, so that the 5 cheek-teeth in D occupy the same relative position in the jaw as did the 5 cheek-teeth in A.

These very curious dental changes render it essential that all statements with regard to the number and kind of teeth present in any given skull should be made with due caution, and it is always better to remove a small flake of bone, and look for the buried teeth, than to make a doubtful diagnosis by merely examining the crowns of the teeth that are cut. In animals older than the stages represented in the figures, the number of the cheek-teeth becomes reduced by the wearing away, and the loss of the foremost members of the series. Aged animals possessing but one molar tooth upon each side of each jaw are occasionally met with; but

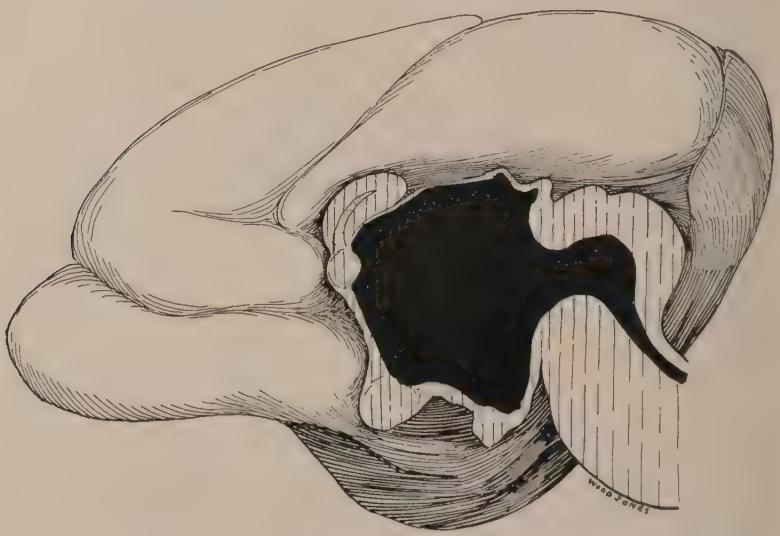


FIGURE 43.—The brain of a wallaby. The brain has been cut into a right and a left half, and the figure shows the right half. The parts cut through in separating it from the left half are marked by vertical lines. The black portion is the central cavity of the brain. This figure should be compared with Figs. 16 and 17. No true corpus callosum is present.

curiously enough this solitary 4th molar continues to move forwards in the jaw; so that the tooth, which was erupted at the extreme hind end of the jaw, ends its career at a site well in front of the root of the zygoma.

Of the more deeply seated distinctions of the Didelphia we need only note – as we did in the case of the Ornithodelphia – the general condition of the brain, and the peculiar organisation of the reproductive system in the female.

The marsupial brain is small when compared with the size of the animal. We have already noted that in the cranium the brain case is very small relatively to the facial part of the skull. The same fact is made evident when we compare the weight of the brain with the total weight of the body of an adult animal. If we take animals which are very roughly comparable in general bulk, such as a man,

a pig, and a large kangaroo, and weigh the brain and compare it with the weight of the body, we will find that the ratio varies widely. The brain of a man weighs about 1 40 of his body weight, a pig's about 1 300, and a kangaroo's no more than 1 800. In some of the small carnivorous marsupials, however, the brain is considerably more bulky in proportion to the body than it is in the kangaroo.

Not only is the didelphian brain relatively small, but, like the brain of the Ornithodelphia, it lacks the great bond of nerve fibres which unites the right and left halves of the brain together. In Figure 43 the right half of a wallaby's brain is shown, and this figure should be compared with those of the ornithodelphian Platypus (Figure 16) and the monodelphian Cat (Figure 17). It will be noticed that, although the linkage between the two hemispheres is more complete in the wallaby than it is in the platypus, the great monodelphian connecting nerve tract (corpus callosum) is still wanting.

We have already noted that the outstanding peculiarity of the reproductive system of the females, which earned for the Sub-class De Blainville's name Didelphia, is the fact that the oviducts of the right and left sides remain separate from each other in the middle line of the body, and that the uterus is therefore essentially double.

This middle line separation of the right and left oviducts is the outcome of an anatomical arrangement, which makes its appearance at a very early stage of development, and which finds its clearest expression in the fact that the ducts of the kidneys (ureters) pass between the oviducts in the Didelphia; whereas the oviducts pass between the ureters in the Monodelphia. (*See* Figures 12 and 13). It is the passage of the ureters between the oviducts that prevents the oviducts from meeting in the middle line and fusing to form a single wide-bored median structure.

The condition of the female reproductive system in the Didelphia is somewhat like that which we have already seen in the Ornithodelphia; but in the Didelphia the oviducts have become specialised into three distinct portions. These three parts are known as the Falloppian tube, the uterus, and the vagina; and there is, therefore, a Falloppian tube, a uterus, and a vagina upon each side of the middle line of the body.

In the Ornithodelphia the egg passes down the oviduct, and is expelled from the cloaca as a shelled egg; but it must not be forgotten that this shelled egg has been undergoing development during its passage down the oviduct. It has been deriving nutriment from the maternal tissues; and it contains a considerable embryo at the time of its extrusion. The ornithodelphian egg, once it is extruded, has, by some means or other, to be assisted into the incubatorium in those forms, such as *Echidna*, in which a temporary brooding pouch is developed.

The didelphian eggs, which develop early traces of a shell-membrane reminiscent of the eggs of the Ornithodelphia, come to maturity while still within the oviduct, and they are arrested in their passage to the cloaca. The embryos, hatched in the uterine portion of the oviducts, make, by their embryonic membranes, a connection with the wall of the uterus for the purpose of deriving nourishment for their further development. The connection which the embryonic tissues make with the maternal tissues varies in different members of the Sub-class, but in all cases it constitutes,

physiologically or anatomically, a functional placenta. Since there is no median uterus, provided with a wide-bored median tubular vagina, in which the embryos may grow to maturity, and through which they may be extruded, the didelphian embryos are limited in the length of their stay in the maternal chambers. They are therefore extruded, or born, in a relatively immature condition, not enclosed in egg shells as are the embryos of the Ornithodelphia, but nevertheless considerably undeveloped when comparison is made with the new born young of certain of the Monodelphia.

The immature offspring extruded from the cloaca does exactly as the immature young of the higher animals do—it grasps a nipple with its mouth, and clings to it. In the business of finding, and grasping a nipple, we know very well that the mother assists the young among the Monodelphia, and probably the same thing applies to the Didelphia. The whole process, from extrusion to nipple grasping, among the pouchless didelphians demands no more explanation than does the similar transition of the young monodelphian, in those cases where the young are extruded in a singularly immature condition. In the pouched didelphians the offspring is transferred to the marsupium, where it becomes anchored upon one of the nipples, deriving its nourishment from its mother's milk, as do the new born young of the Monodelphia. When growth has proceeded sufficiently far to enable the young animal to lead a partly independent existence it becomes free of the nipple, but, in pouched forms, continues to live in the pouch, suckling only at intervals, until it is able to shift for itself. Even after pouch life proper is done with, the young animal still suckles after the manner of a monodelphian infant.

In the pouchless forms the young merely hang from the nipples, and are thus dragged about by the mother. Considerably more than a month is spent by the young in this position in certain pouchless forms, and, towards the end of the period of adhesion to the nipples, the young animals present a most remarkable load, which is dragged about by the mother in all her foraging activities. (*See* Figure 81.) Such are the broad outlines of marsupial reproduction ; for the most part they were established nearly a century ago. There would be no need to fill in this outline with further detail but for the fact that, in Australia, the whole question of marsupial reproduction has become surrounded by such a maze of prejudice, misrepresentation, and ignorance that no bald statement of the actual plain facts will suffice.

Before further study may be made of the process of reproduction it is necessary to define with some degree of precision the parts of the internal genital system of the female. There is no doubt that complete ignorance of the anatomy of the reproductive system accounts for the erroneous beliefs that are, from time to time, current. The typical condition, as it is seen in a young female animal that has never been pregnant, is shown diagramatically in Figure 44. It will be noticed that a narrow tubal portion of the oviduct leads from the ovary to the wider uterine portion, and that from the uterine neck a narrow canal runs backwards close to the middle line, and then bends upon itself to run as a long tube that opens into a chamber situated at the posterior end of the body. The long tube that runs from the uterine neck to the posterior chamber, or uro-genital sinus, is named the vaginal portion of the oviduct. The vaginal portion is divided into two parts ; the part that immediately follows the uterine neck and lies towards the middle line of the

body, and the part which runs backwards on each side of the body to the uro-genital sinus. These parts are named respectively the median and lateral portions of the vagina. The angle where the median vagina turns to join the lateral vagina is marked as a little recess, which afterwards becomes of the greatest importance, and which is known as the vaginal cul-de-sac. The bend in the lateral vagina, which lies nearest to the head end of the animal is dilated into the form of a capacious thin-walled chamber ; this chamber is best named from its structure, as the vaginal caecum ; or from its function, as the receptaculum seminis.

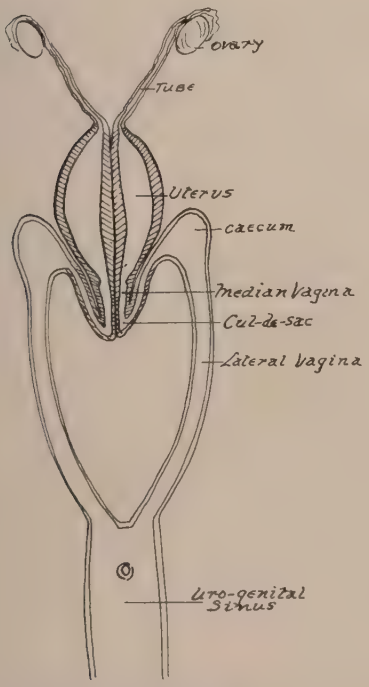


FIGURE 44.—Simple diagram of the reproductive system of a female marsupial. Stage I.

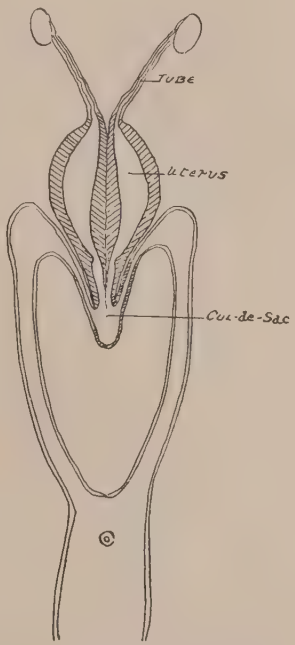


FIGURE 45.—Simple diagram of the reproductive system of a female marsupial, showing advances upon the stage illustrated in figure 44.

It is necessary to point out that the kink in the oviduct which leads to the differentiation of a lateral and a median portion of the vagina, and to the development of the cul-de-sac, is caused by the passage of the mesially situated ureter. (*See* Figs. 12 and 47).

Some degree of formation of the cul-de-sac may, therefore, be said to be a necessary part of the marsupial anatomy. But the degree of development of the backwardly directed median portions of the vaginae differs greatly in different marsupials. The condition which is represented diagramatically in Figure 44 shows the state of affairs actually present in the bandicoots, but in many other types advances have been made from this stage. In the first degree of advance the wall

between the two cul-de-sacs is broken down, and a single median vaginal pouch is formed. This stage is illustrated in Figure 45. The median vagina is a process that may be of very different lengths in different species, and in some forms it extends to a blind termination which is almost in contact with the wall of the uro-genital sinus. A long median vaginal canal is typical of the kangaroos and wallabies, whereas a short cul-de-sac is characteristic of the bandicoots.

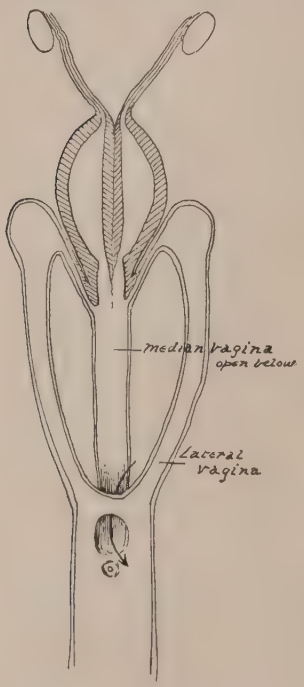


FIGURE 46.—Diagram of the reproductive system of a female marsupial in which the median vagina opens below into the uro-genital sinus.

All the facts with regard to fertilisation are well established. The lateral vaginal canals are the channels by which fertilisation of the eggs, shed from the ovaries, is effected. The vaginal caeca become distended, and function in their capacity as receptacula seminis. The fertilised egg then passes into the uterus, and with the uterine wall makes some degree of placental connection, and enters upon its stages of interuterine development.

The placenta of the bandicoots (*Peramelidæ*) was described with the utmost minuteness by Professor J. P. Hill in 1897, that of the native cats (*Dasyuridæ*) by the same authority in 1900, and the embryonic membranes and uterine connections of other forms have been described and figured by other authors.

The period of utero-gestation varies in different forms, and in all cases it is one which is difficult to determine exactly. As we shall see later, there is evidence that the period is far from constant in some species. Selenka in 1886 concluded, from observations on the American Opossum (*Didelphys*), that the stay in the uterus was barely eight days. Hill studied a very large number of cases of breeding of the Native Cat, and he records that the shortest period from pairing to the birth of the young was a little over eight days. In Owen's classical case of observation on the kangaroo, and in several other instances of the breeding of kangaroos in captivity, the period has been recorded as being about five weeks.

The actual route for the birth of the young was declared by Sir Everard Home, so long ago as 1795, to be the median vagina. The specimens which Home examined, and from which he drew his conclusions, were certain pregnant uteri of kangaroos, which had been sent to the illustrious John Hunter not long before his death. It is an interesting question, easily asked but impossible to answer, how far Home's assertion that the median vagina was the channel of birth was based on observations already made by Hunter on his specimens.

Hunter had dissected several Australian marsupials, and was fully alive to the

peculiarities of their reproductive history. He said in one of his essays, "I have a great many facts respecting them; yet I am not certain that I am possessed of sufficient information to complete our knowledge of the system of propagation in this class." John Hunter died in 1793; in 1795 Home made the fundamental statement that the lateral vaginae were apparently not the route by which the embryos reached the exterior.

Home's opinion was not accepted by all zoologists, for the simple reason that in many female marsupials that were dissected, the median vagina was present only as a cul-de-sac, or as a longer, but still blind, passage ending somewhere near the wall of the urogenital sinus. It was obvious that, in these females, the only passage from the uteri to the exterior was by way of the lateral vaginae. Yet it was equally certain that in many animals, which had been examined by competent anatomists, the condition was as Home described it in John Hunter's specimens. This condition of a median vagina open to the exterior is illustrated diagramatically in Figure 46, and by a drawing of an actual dissection in Figure 47. These facts led to considerable controversy, and the next advance in knowledge came in 1881 when J. J .Fletcher and J. J. Lister, working on kangaroos, brought to light the general truth that the median vagina was present in animals that had born young, and that it was absent in the very young female. In 1889 Sir Edward Stirling dissected a female kangaroo in which an embryo was actually passing down the median vagina, and so the route by which birth took place was settled for, at any rate, certain of the Macropodidae. In 1899 Professor J. P. Hill studied the processes of parturition in the bandicoots. In these animals, as we have seen, the median cul-de-sacs are short, and the distance from their blind lower ends to the uro-genital sinus is considerable. At parturition, an actual rent is made in the tissues intervening between the median vagina and the uro-genital sinus, and the nascent

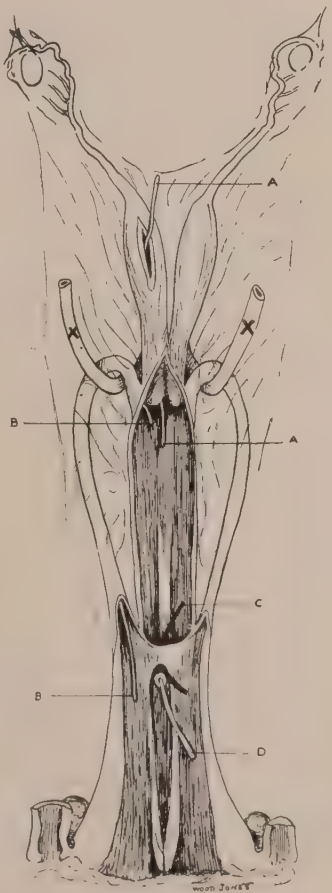


FIGURE 47.—The reproductive system of a female Nail-Tailed Wallaby. A. A. is a probe inserted through a hole made into the uterus and passed out through the orifice of the uterus into the median vagina. B. B. is a probe passed along the lateral vagina. C. is a bristle placed in the opening of the median vagina to the exterior. The probe D. is in the outlet of the urethra. In this animal the median vagina is an open canal. The ureters are indicated by X.

young pass through this newly formed channel. This channel once formed during parturition remains permanently open in some species (such as kangaroos), but in some (such as the bandicoots) it closes up again, only to be re-opened at the next act of parturition.

The condition of the reproductive system of practically all the marsupials is now well known, and a medium vaginal passage, formed in the first place during parturition, and in some types reformed at each subsequent act of parturition, constitutes the route of birth in all. Although the median vagina becomes a permanent structure in many forms, nevertheless, the lateral vaginae still serve as the channels of fertilisation. The lateral dilatations of the lateral vaginae, which serve as receptacula seminis, find their parallels in other animals, and their presence is probably responsible for the very strange irregularity which has frequently been noted in the period of gestation of such marsupials as kangaroos, which are commonly kept in captivity. The following records relate to the Red Kangaroo (*Macropus rufus*): A female, which paired on a single occasion, May 22nd, 1921, died 28 days later, and in her pouch was an embryo 55mm. in length. In several cases pregnancy has been recorded as lasting from 30 to 40 days.

A female and a male were kept together; in February, 1922, the male died, and on July 4th, 1922, an embryo "not so large as the diameter of a shilling" was found in the female's pouch. The interval in this case was some 130 days. A male and a female sent to the Zoological Gardens in Philadelphia lived together, the male dying on October 28th, 1908. An embryo was noticed in the pouch seven weeks after the male died. This young one suckled till November 7th, 1909; but on September 25th, 1909, another, apparently new born, embryo was noticed in the pouch. The interval in this case being eleven months all but three days. These curious cases are not without their parallels in the Monodelphia, and the European Badgers, certain Stags, and the Bats of cold countries might be instanced as examples of animals notorious for possessing very irregular and sometimes greatly prolonged periods of "gestation."

Two other rather strange phenomena may be noticed in connection with marsupial reproduction. In many monodelphian Mammals there is an over-production of embryos; more eggs are fertilised, and more embryos start to develop than ever come to maturity. That is a well known state of affairs. But in certain Didelphia the over-production goes further than this, for, as Professor Thomson Flynn has noted, six embryos may be produced in the Tasmanian Ring-tailed Opossum which never rears more than two young. Some of these excess young probably do not reach the pouch; but some do, and then failing to find an unoccupied nipple, perish.

Again it may happen that the embryo in one uterus differs in size and age somewhat widely from that in the other uterus; or a very immature embryo may be present in the uterus while a new-born young animal occupies the pouch.

The young marsupial at the time of its birth is very small in proportion to the size of the parent animal, but small though it is it evinces a high degree of vitality and an astonishing power of movement. New born young will remain alive for a considerable time after the death of the mother, and if taken in the hand are capable of wriggling about with remarkable vigour.

As we have already noted, the newly born young of the pouchless marsupials has no greater task confronting it than has the young of the Monodelphia. It merely has to find a nipple and grasp it. We know quite well that the monodelphian mother assists the young to do this ; and the didelphian mother probably does the same.

In the pouched forms, the young, in order to grasp the nipple, has to get into the pouch. In this further enterprise it is also most probably assisted by the mother ; and in this connection it is to be noticed that the mouth of the marsupium is directed so that it is in the situation most easily reached by the mother. The position most easily reached depends upon the general build of the mother. Female marsupials frequently examine their pouches, and before parturition a female opossum is constantly looking into her pouch, holding its mouth open with her hands, and thrusting her nose within its cavity. In all probability the mother assists the young to effect its entry into the marsupium, and it is reasonable to suppose that she does it with her nose and tongue in the manner in which a monodelphian mammal guides the young towards the nipples.

FIGURE 48.—Transverse section of the nipple of a wallaby. The young one had been recently born and was hanging to the nipple. The specimen was prepared by cutting thin slices through the head of the young animal, the nipple being sliced as it was held in place in the young animal's mouth. The slice is shown as seen under a microscope. Eighteen little ducts (M.D) convey the milk along the nipple to the offspring.

When once the young has grasped the nipple, its mouth becomes adapted to its circular form, and instead of the gape between the lips being slit-like in shape it becomes rounded. As John Hunter said, "the sides of the mouth are united something like the eyelids of a puppy just whelped." The nipple, which passes far into the mouth of the embryo, dilates at its tip and so cannot be pulled from the mouth without causing some injury to the sealed lips. As the young marsupial grows larger the fusion of its lips becomes undone—as the eyelids of a puppy part when the eyes open—and then the nipple may be freely withdrawn from the mouth. The number of nipples varies in the Australian marsupials from 2 in the Wombat

and the Koala and some of the Opossums to 10 in certain Pouched Mice. The nipples are inconspicuous and inverted until they begin to develop for their adult function and are pulled out by the suckling offspring. The section across the nipple of a wallaby is shown in Figure 48, and it will be noticed that it is traversed by no canal save the minute ducts along which the milk passes from the mammary glands.

THE DISTRIBUTION, AND PAST HISTORY OF THE DIDELPHIA.

The Didelphia at present inhabit Australasia (exclusive of New Zealand) and certain parts of America. The American marsupials, although an extremely interesting group, constitute a struggling minority, and Australasia to-day can claim to be the stronghold of the most specialised, and the most perfected, examples of marsupial development.

In Australasia there are about four times as many species living as are comprised in the whole of the existing marsupial fauna of America. In the New World, the vast bulk of the species is confined to South America; but certain forms range through Central America, and some few extend northwards to the southern United States. In Australasia, their distribution extends through the Malayan Islands from Celebes, Gillolo, Ceram, Amboyna, Waigou, Aru, Key, Salayer, Buru, and Timor to New Guinea, and as far to the east as the Louisiade Archipelago. They range through the the whole of the continent of Australia, and into the small islands of the continental shelf, and so to the extreme south of Tasmania.

In Australasia the marsupials have become established, and the probable route of their invasion has already been discussed (pp. 20-23). In that discussion we noted that very different views are entertained by zoologists upon the question of the road by which the marsupials arrived in Australia.

When we turn to the other question—"When did the marsupials arrive?" we meet with a still greater diversity of opinion. But though there are very different ideas as to the duration of their tenancy of Australia, there is a very definite tendency for each fresh addition to our knowledge to force us to the belief that this tenancy has, geologically speaking, not been a very long one.

Sir Richard Owen assumed that the Marsupials had been in Australia from Mesozoic times, and many authorities have placed the period of their advent in the Jurassic. Some have, however, shortened their tenure to the Cretaceous period, and some even have limited it to the Eocene epoch of Tertiary times. Zoologists, for the most part, have been impressed with the evidence of the comparatively recent stamp of the marsupial radiation in Australia. There is one thing that is very certain, namely, that during the period which corresponds to the Pleistocene of Europe the Didelphia were well established all over the continent of Australia; and that during this period they ran riot in the production of peculiar and outstanding forms, which have since become extinct. During this period, the relatively gigantic Diprotodons lumbered about the now arid regions of the Centre, the very formidable flesh-eating *Thylacoleo* flourished, and the huge extinct kangaroos ranged over practically the whole of the continent. Since that time the Australian Marsupials have passed their hey-day, and we are witnessing the all too rapid extinction of the stock. In Europe, the Marsupials had all died out at the beginning of the Miocene period, and from North America they had already passed as early as

the Oligocene. Their future tenure of Australia depends upon the realisation by the people of Australia of the scientific value of their heritage of Marsupials—a heritage for which they are responsible to the whole world. In studying the living Marsupials of Australia, we are at first struck by the remarkable fact that, in a general way, they have become modified along just the same lines as have been followed by the monodelphian mammals of the rest of the world. This phenomenon of Convergence we have already discussed. But, when the modifications of the whole of the didelphian series are passed in review, it at once becomes apparent that, though there is a considerable degree of diversity of marsupial forms, this diversity is not nearly so great as that which exists among the Monodelphia. We may say that a greater likeness exists between all marsupials than exists between the very diverse types of higher mammals. There is a striking underlying similarity between all Didelphians. They have radiated and become modified; but their modifications have not proceeded so far as have the modifications of the Monodelphians. There is more underlying likeness, for instance, between a kangaroo and a native cat than there is between a bat and an elephant. We may say that, whereas, in the Monodelphia, modification of the stock has proceeded so far that several separate Orders have to be created in the classification to accommodate the very diverse forms, the whole of the Australian Didelphia may be placed within the limits of a single Order.

Now, this state of affairs is probably brought about by two factors. In the first place, the Didelphia, as a group, have largely lost their plasticity. They are not able to react quickly to their environmental demands, or to adapt themselves by structural modification to all sorts and conditions of new circumstances. In the life of an individual—even a human individual—there is a time during which change, in response to new demands of the environment, can be readily and rapidly effected. So, too, in the life of a stock or *phylum*, there is a period of youthful plasticity, and a time when this plasticity becomes less and less; and in the end a stock becomes phylogenetically senile in the same way that an individual becomes aged. Regarded in this way, it may be said that the Didelphia have become phylogenetically senile; they have outlived their time of greatest plasticity, and now cannot adapt themselves so readily to new conditions. It was apparently in Pleistocene times that the Australian Didelphians ran their riot of phylogenetic plasticity, and since then they have sunk into phylogenetic decrepitude.

This lack of plasticity, no doubt, accounts in part for the comparative lack of diversity displayed by the existing forms of the Australian marsupials. But in part this sameness is probably also due to the relatively recent nature of the radiation of the marsupials into Australia. If we take such a feature as the pattern displayed by the coats of the Marsupials, we are at once struck by the wide prevalence of the loin banding. This type of pattern is seen in such diverse Marsupials as the Tasmanian Tiger (*Thylacinus*); in the Banded Ant-eater (*Myrmecobius*); in certain of the Bandicoots: and in some of the Wallabies. The prevalence of so variable a feature as a particular type of coat pattern throughout the whole of the most widely separated members of the Australian Marsupials appears to indicate that their diversity is comparatively recent. They are diversified as the result of their original radiation into Australia, but it would seem that their radiation had not started very long ago, when time is reckoned by geological epochs.

THE PLACE OF THE DIDELPHIA IN THE MAMMALIAN PHYLUM.

Some years ago there would have been but little difficulty involved in the discussion of the question as to the relationship of the Didelphia to the Monodelphia on the one hand, and to the Ornithodelphia on the other. When once evolutionary principles, even of the crudest kind, had been grasped, it was easy to assign an intermediate position to the Didelphia; to regard them as representing half-way houses in development between the primitive Ornithodelphian and the more elaborated Monodelphian. Haeckel, for instance, was quite dogmatic in his teaching; and he says "Metatheria or Marsupialia are direct descendants of Prototheria: but they show higher development by the reduction of the coracoid bones," etc. Of the Monodelphia, he says that they are "a further development of the Metatheria by the development of a placenta, loss of the marsupium and the marsupial bones," etc. In 1898, when Ernst Haeckel wrote his essay* the whole sequence seemed easy, and the line of thought he followed was a very simple one. To picture the stage intermediate between a mammal which lays an egg, and a mammal which produces a well matured offspring, as being a creature which produces a very immature embyro—such as that typical of the marsupials—is perfectly natural. The reproductive story of the Didelphia seemed to be an ideal stepping stone between the egg-laying habits of the ornithodelphian Platypus, and the begetting of a remarkably mature offspring of, say, the monodelphian mare.

Again, we have seen that the Platypus lays eggs, but has no pouch; whereas Echidna lays eggs, and develops at the breeding season a pouch in which the egg is placed, retained, and hatched; and within which the young is nourished by a nutrient fluid or "milk."

It appears a very simple step to the Didelphian, where an immature young animal—a stage only very little advanced from the egg—is placed in a pouch when it is born. It also seems a simple step from the milk glands without nipples, seen in the Ornithodelphia, to milk glands with nipples, typical of the Didelphia. It would appear natural, also, that, as the offspring was born more and more mature with the progress of evolution, the pouch should ultimately be dispensed with, and the monodelphian condition attained.

Unfortunately, a series of well ascertained facts upsets our belief in this very simple evolutionary story, and it is quite impossible to accept Haeckel's easy assertions as to the intermediate position of the Didelphia.

In the first place, although it might seem obvious that the didelphian "pouch" was the direct descendent of the ornithodelphian "pouch," we are faced with the disconcerting fact that the most generalised, and most primitive Didelphians have no "pouch" of any kind.

Contrary to what is the general notion concerning the marsupials, it is, nevertheless, certain that the pouch was no birthright of the didelphian stock; the "marsupium" is a marsupial acquirement, and a marsupial specialisation; it is by no means a didelphian birthright.

So much a mere study of the animals tells us, for when we examine a marsupial such as *Myrmecobius*, which shows a maximum of archaic, primitive, or generalised characters, we find no trace of a pouch at any period of the animal's life cycle.

*The Last Link, London, 1898, pp. 66—67.

From such an entirely pouchless condition we may pass, by easy gradations, to partially and temporarily pouched forms, and finally to permanently and perfectly pouched forms; this last group being the most completely specialised marsupials, but the least primitive Didelphians.

No amount of ingenuity can make it a credible thesis that the most completely pouched Didelphians are the most primitive, since in every other feature of their bodily anatomy they are obviously the most specialised away from a primitive condition. It therefore seems hopeless, on mere commonsense grounds, to attempt to explain the marsupial pouch as an inheritance of the ornithodelphian pouch of *Echidna*; and this commonsense view is backed by every finding of science, and science should be merely a synonym for applied commonsense.

The *Incubatorium*, or brooding pouch, of Echidna is in its inception, its structural basis, and in its developmental history a thing altogether different from the *Marsupium*, or mammary pouch, of the more highly specialised marsupials.

We have spoken previously of the importance of the phenomenon of Convergence, by which not only individual bodily structures, and organic systems, but the whole summation of structures expressed in the form of an adult animal, may come to be moulded in a similar fashion in response to similar environmental needs. By convergence, in distinct opposition to inheritance, or kinship, the marsupial Mole comes to resemble the monodelphian Mole. By convergence, in distinct opposition to inheritance, certain members of the Ornithodelphia and the Didelphia independently acquired a depressed area of the ventral abdominal surface, which, though known in both cases as the "pouch," is fundamentally a different structure in the two Sub-orders.

Although the Marsupium is no descendent of the Incubatorium, nevertheless, there are many structural points in which the Didelphia show their affinity with the Ornithodelphia. The epipubic bones, and the brain lacking a true corpus callosum, may be mentioned as structural affinities of Marsupials and Monotremes. The didelphian stock is obviously allied to the ornithodelphian, even if its relationship to that stock is not of so simply derivative a kind as was at one time supposed. But if the relationship of the Didelphia to the Ornithodelphia cannot be regarded as one of perfectly simple descent, the relationship of the Didelphia to the Monodelphia is, still more obviously, not one of simple ancestry.

If the didelphian series be arranged in a sequence, from those forms which show a maximum of primitive characters to those which evince the greatest degree of specialisation, it is at once apparent that it is the most primitive, and not the most specialised Didelphians which most resemble the Monodelphians. It is not that a didelphian stock underwent progressive evolution, and culminated in the production of a monodelphian type; for the lowest, and not the highest, Didelphians are most like the Monodelphians. The two great stocks meet at their bases—the base of the higher does not start from the apex of the lower. The meeting of the didelphian and monodelphian stocks at their bases is well shown in the reproductive story of the two groups. The most primitive Didelphians possess no pouch, and in all the more primitive forms the pouch is of only moderate development. The young animal, before its birth, establishes connection with the maternal uterus by means of a placenta, which, though comparatively short-lived as a functioning

organ, is nevertheless fashioned definitely in a manner familiar in the Monodelphia, or so-called "placental." Mammals. The young animal is born immature, and hangs on to the maternal nipple; but, in the primitive Didelphians, the nipple, and the young, are not protected within a marsupium.

All this is very like the state of affairs present in the lowest Monodelphians, for, in many placental Mammals, the placenta functions for a comparatively short time, and the young is born singularly immature; moreover it is the custom in many Monodelphians for the young to hang extremely tightly to the nipples, and to be thus dragged about by the mother in all her activities.

It may be said that the reproductive history of the most primitive marsupials, and the most primitive placentals is, on general lines, not very dissimilar. It might also be added that the Didelphians seem to have specialised in the development and protection of immature young; whilst the Monodelphians have advanced in the direction of begetting a more advanced offspring.

But though, in structure and function, we find a very striking similarity between primitive Didelphians and primitive Monodelphians, it is a very great mistake to suppose that the two groups actually lose their distinctive characters when traced back to their bases. In speaking of the Didelphia (Metatheria) the authors of one of the most recent publications* on the Australian fauna say, "There is not a hard and fast definition by which they may be separated from the Eutheria" (Monodelphia). There is, however, one hard and fast definition which will suffice, and this one is of the utmost importance. In the Didelphia the ducts of the kidneys (ureters) pass between the oviducts; in the Monodelphia the oviducts pass between the ureters. This difference is one which is established very early in embryonic life, at the time when the kidneys are developing; and it is the essential factor which determines the reproductive peculiarities of the two great subdivisions of the Mammalia. Since the ureters pass between, and separate, the oviducts of the Didelphia, these ducts cannot meet in the mid line, and fuse to form a large single median uterus with a wide bored median orifice opening to the exterior. The offspring of the Didelphia must therefore always be born prematurely, or, at any rate remarkably small, when compared with the size of the parent.

From the condition of the oviducts and ureters present in the Ornithodelphians, it is easy to derive either the condition typical of the Didelphia, or that typical of the Monodelphia; just as the derivation of either didelphian or monodelphian type is simple from the condition present in the early embryo of either.

We may, therefore, picture the Didelphia and the Monodelphia as arising from a common, and more primitive stock, which, in many of its characters, resembled the Ornithodelphia.

From this common stock the Didelphia developed along a line expressed by, among other things, the degeneration of the allantoic placenta, the curtailment of intra-uterine life, the begetting of immature offspring, and the development of a marsupium or pouch in which to shelter them. Whereas, the Monodelphia diverged by, among other things, the elaboration of the allantoic placenta, a prolongation of intra-uterine life, and the begetting of a somewhat more mature offspring.

* Animals of Australia. Lucas and Le Souef, p. 3.

THE CLASSIFICATION OF THE DIDELPHIA.

To arrive at a thoroughly satisfactory classification of the Didelphia is by no means an easy matter; and the difficulties that are encountered will depend, to some extent, upon the motive that underlies the attempt to arrange the Marsupials in an orderly series.

Classification may be undertaken merely with the idea of arranging specimens in a collection, or agreeing upon the order in which the animals should be placed in a catalogue, or a book. Or the arrangement may be planned in order to make some attempt to express actual lines of descent, and degree of relationship. It seems obvious that a scheme of classification that tells us something of the real affinities of the animals is to be preferred to one that only attains a certain degree of systematic orderliness.

The whole assemblage of the Australian Marsupials is readily divided into two main groups by reference to the structure of the pes. It is also divided into two different groups by reference to the characters of the dentition. We may say, in brief, that, if our aim in classification is to make an ordered arrangement of a collection of specimens, the dentition constitutes the best criterion; whereas, if our aim in classification is to show true genetic affinities, the structure of the pes is probably the safest guide.

There are among the Marsupials, as among the Monodelphia, certain forms which are carnivorous, and others that are herbivorous. No classification by dietary can ever be a very precise one, for some animals will certainly be met with which are neither wholly flesh eaters, nor wholly vegetarian. Nevertheless, the dentition of an animal shows, as a rule, into which class the creature should be placed; for the teeth usually betoken the habit, and the heritage of an animal's dietary in an unmistakable manner. Arranged by the dental characters, the Marsupials, therefore, fall into two groups; the one group having, on the whole, a carnivorous type of dentition, and the other an herbivorous type. In the flesh eaters, there is usually a full set of anterior teeth; but in the vegetarians, the front teeth tend to be few in number, though large in size as individual teeth. The flesh-eating Marsupials were, therefore, isolated into a group having as a well-marked characteristic the possession of numerous front teeth; and this group was, accordingly, named *Polyprotodontia*. The vegetarian group was distinguished as the *Diprotodontia* in consequence of the reduction in the number of front teeth. The division of the Didelphia into two groups, Polyprotodontia and Diprotodontia, is the standard classification adopted in most text books of zoology. Within the last twenty years, however, there has been a tendency, on the part of many workers, to attach greater importance to the structure of the pes as a guide to classification; and Bensley, among others, has emphasised the value of the study of the condition of the pedal digits. Judged by the characters of the foot, the Australian Marsupials may be arranged in two groups, named *Didactyla* and *Syndactyla*. In the Didactyla the foot is characterised by the possession of the primitive arrangement in which all the digits remain separate and independent of each other. In the Syndactyla, the 2nd and 3rd pedal digits are bound together, over the greater part of their length, so that they appear as a single toe possessing two toe nails.

For the most part, the Polyprotodontia are also Didactyla ; and the Diprotodontia are Syndactyla. That is to say, most of the carnivorous Marsupials, with many front teeth have their toes separate ; whereas the vegetarian Marsupials, with few front teeth, have the 2nd and 3rd toes united.

Unfortunately, the Bandicoots (*Peramelidae*) spoil the agreement of these two schemes of classification, for these interesting animals, which are mixed feeders, are Polyprotodont, and yet they have typical syndactylous 2nd and 3rd toes.

If the characters of the dentition be relied on, one Sub-order (Diprotodontia) is created, in which all the animals have a reduced set of front teeth, and all possess syndactylous digits. The other Sub-order (Polyprotodontia), however, contains an assemblage of animals, all of which have a full set of front teeth, but some have simple feet, and some (the Bandicoots), have feet like those of the animals contained within the other Sub-order.

If, on the other hand, the feet be used as the criterion, we have a Sub-order of simple-footed animals (Didactyla), all of which have a full set of front teeth ; and a Sub-order of syndactylous animals (Syndactyla), all of which have reduced front teeth, except the Bandicoots.

In such a case as this, it is necessary to make some attempt to determine the relative values of the characters used as criteria for classification. There is no doubt that didactylism is the simple and primitive condition ; and that syndactylism is a specialised, or derived character. There is equally no doubt that the diprotodont condition is the specialised form which has been derived from the more primitive polyprotodont condition. We may, therefore, feel fairly certain that the most primitive didelphians were polyprotodont and didactylous ; and that the diprotodont and syndactylous forms are the most highly specialised expression of Marsupial development.

Has a primitive didactylous stock split up into polyprotodont and diprotodont forms ? or has a primitive polyprotodont stock split up into didactylous and syndactylous forms ? If the first supposition were true, we should expect to find, either as living or fossil forms, marsupials having reduced front teeth, but with simple feet, thus :—

Didactylous Stock.

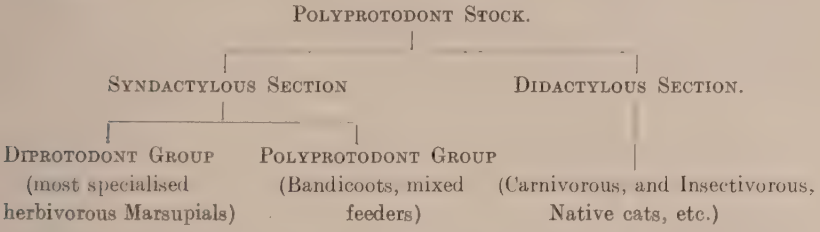
Didactylous Polyprotodont Group (with simple feet, and many front teeth)	Didactylous Diprotodont Group (with simple feet, but reduced front teeth)

No didactylous diprotodont marsupial is known. On the other hand, if the second supposition is true, we shall have the following groups :

Polyprotodont Stock.

Polyprotodont Syndactylous Group (with many front teeth and syndactylous feet),	Polyprotodont Didactylous Group (with many front teeth and simple feet).

Both these divisions are represented in the living Marsupial fauna of Australia. We have further to picture, as a subsequent development of this, the specialisation of a dentition with reduced front teeth among the vegetarian syndactylous division, as follows :—



From the genetic point of view, it, therefore, seems obvious that the two main divisions of the Didelphia are the *Didactyla* and *Syndactyla*, and not the more usually employed *Polyprotodontia* and *Diprotodontia*.

Despite the fact that all current works on systematic zoology still adopt the classification by teeth introduced by Sir Richard Owen, the more recent suggestions of Bensley and others will be used as a basis here, and the major classification will be by foot structure. The following probably represents as true a picture of the relationships of the various groups as can be constructed in the present state of knowledge.

Didactylous Group.

Most primitive members of the Didelphia, in many ways most resembling the more primitive members of the Monodelphia. The pouch is commonly either altogether absent, or is rudimentary ; but in some forms it is well developed ; its opening is directed ventrally, or caudally. The teeth are adapted to an insectivorous, or carnivorous diet. The bulk of the didactyla are exceedingly lithe, active creatures ; possessing that general ability for climbing, which enables them to ascend trees without their being strictly arboreal animals. Some are bush haunting animals, some are terrestrial, and one is fossorial. They are, as a rule, alert, intelligent creatures, preying upon almost any living thing that they can overpower and kill. As is common with carnivorous creatures, a species is not represented by a great number of individuals ; and many are excessively rare.

The group embraces the Native Cats and Tiger Cats ; the insectivorous Pouched Mice ; the Tasmanian Devil, and the Tasmanian Tiger ; the Banded-Ant-eater, and several small weasel-like forms. The most primitive members of the group are probably to be seen among the *Phascogalinae*, while the most specialised are the large existing carnivorous Marsupials of Tasmania, and the jumping *Antechinomys*, and the burrowing *Notoryctes* of the Centre.

Syndactylous Group.

Most specialised representatives of the Didelphia. The most primitive members of the group are the mixed-feeding, but largely carnivorous, Bandicoots. The

Bandicoots possess the full series of front teeth typical of the Didactylous group, and they are an active, predatory, and relatively intelligent family of generalised Marsupials. The most specialised of the Bandicoots are the Rabbit Bandicoots (*Thalacomys*), and the Pig-footed Bandicoots (*Choeropus*). The pouch is shallow in all, and the opening is ventral.

The remainder of the Syndactyla are vegetarians, and show a reduction in the number of the front teeth. This section includes the various Opossums, the Kangaroo Rats, the Wallabies, and Kangaroos, and the Wombat and Koala. All these animals are highly specialised; but the least modified of them all are the Opossums.

In all of them the pouch is well developed, and its opening is directed forwards. They are arboreal; saltatory, terrestrial; or fossorial. They are, for the most part, rather markedly unintelligent, and many are distinctly phylogenetically senile. They are the end products of Didelphian development, the most advanced phase of specialisation of the Marsupial stock.

Sub-Class II.—**DIDELPHIA.**

Order, MARSUPIALIA.

Sub-Order I.—DIDACTYLA.

KEY TO THE SUB-ORDER.

(A) With well developed eyes, and external ears. Cervical vertebrae not fused together. In the general appearance there is nothing mole-like.

(B) With well developed molars—$\frac{4-4}{4-4}$

(C) Hallux well developed. Tail wholly, or in part, naked; prehensile. Family 1. *Didelphidae.*

(C^1) Hallux not well developed; often absent. Tail more or less hairy; not prehensile.

(D) With molars having many secondary cusps. Family 2. *Dasyuridae.*

(D^1) With molars having few secondary cusps. Family 3. *Thylacinidae.*

(B^1) With degenerate molars exceeding $\frac{4-4}{4-4}$ Family 4. *Myrmecobiidae.*

(A^1) With eyes atrophied, and external ears absent. Cervical vertebrae fused together. General appearance mole-like. Family 5. *Notoryctidae.*

Family I.—**DIDELPHIDAE.**

The members of this Family are carnivorous Marsupials, and are the animals to which the name of "Opossum" rightly belongs. They are all confined to America.

Family II.—DASYURIDAE.

This Family is most conveniently divided into two Sub-Families.

(A) Medium sized animals ; in general form like the Martens or smaller Felidae among the Monodelphia. Carnivorous. Upper premolars 2–2.
Sub-family 1. *Dasyurinae.*

(A[1]) Small animals ; in general form like the Shrews and Tree Shrews among the Monodelphia. Insectivorous. Upper premolars 3–3.
Sub-family II *Phascogalinae.*

Sub-Family I.—DASYURINAE.

Division of the Sub-Family into Genera.

(A) Fur not spotted. Skull with the brain case small and muzzle broadened.
Genus 1. *Sarcophilus.*

(A[1]) Fur spotted. Skull with the brain case relatively large and the muzzle elongated. Genus. 2. *Dasyurus.*

Genus 1. SARCOPHILUS (F. Cuvier, 1837).

This Genus contains only a single living species—the so-called Tasmanian Devil. The animal formerly ranged over continental Australia, but is now confined to Tasmania, where it maintains a rather precarious foothold in the wilder parts of the country.

In 1912 a Tasmanian Devil was captured in Victoria, and another was reported as having been seen (*see* Kershaw, Vict., Nat. xxxix., 1912, p. 76). In the absence of any additional evidence it is perhaps prudent to regard these animals as being specimens escaped from captivity, rather than as survivors of the ancient race which inhabited continental Australia ; nevertheless, this possibility must not be overlooked.

Genus 2. DASYURUS (Geoffroy, 1796.)

The animals embraced within this Genus roughly resemble small Cats, and they are known as Tiger Cats or Native Cats. The rhinarium is naked and grooved. The ears are long and somewhat pointed. The body fur marked with white spots. Tail long and uniformly hairy. The soles and palms naked, or nearly so ; granular in texture. Hallux reduced or absent. Digits armed with strong claws. Pouch present, opening downwards. Nipples 6–8 ; arranged in two curved rows. Active animals, capable of climbing ; but most species not truly arboreal. Often living in rocky and treeless areas. Carnivorous and insectivorous. Dentition—I. $\frac{4-4}{3-3}$ C. $\frac{1-1}{1-1}$ PM. $\frac{2-2}{2-2}$ M. $\frac{4-4}{4-4}$.

Three species are recorded from South Australia.

KEY TO THE SOUTH AUSTRALIAN SPECIES.

I. External characters—

(A) Size large. Tail spotted. Pads of feet striated. Hallux present. *D. maculatus.*

(A^1) Size medium. Tail not spotted. Pads of feet tuberculated.

(B). Hallux absent. Tail (in typical colour form) becoming paler at tip. *D. viverrinus.*

(B^1) Hallux present. Tail becoming darker at tip. *D. geoffroyi.*

II. Cranial characters—

(A) Bullae obliquely oval. Molars 1-3 18mm. or more. *D. maculatus.*

(A^1) Bullae spherical. Molars 1–3 less than 18mm.

(B) Posterior part of palate comparatively perfect. *D. viverrinus.*

(B^1) Posterior part of palate with large vacuities. *D. geoffroyi.*

(1) Tiger cat. Spotted-tailed native cat.

DASYURUS MACULATUS (Kerr, 1792).

The name Tiger cat which is usually bestowed upon this animal is a somewhat flattering one; for, although a particularly well equipped carnivore, its comparatively small size hardly justifies its comparison with the true Tiger Cats of the genus Felis.

Specimens are said to have been seen as large as a common fox; but a head-and-body length of about two feet may be regarded as a fair average size.

In general build it is like the Martens of the northern hemisphere, and Captain Phillip, who saw the animal in Tasmania, and was the first to record its existence, named it the "spotted marten."

FIGURE 49.—Skull of *Dasyurus maculatus*. Natural size.

The fur is thick, harsh, and rather short. Beneath the stiffer surface hairs of the coat is an abundant soft brown under fur. The general colour of the dorsal surface of the body varies from a rich rufous brown to dark brown. The inner side

of the limbs, and the ventral surface of the body, are paler, and vary from pale yellow to sandy. The face is paler than the general colour of the dorsal surface of the body, and the short hairs which clothe the face and head are somewhat grizzled.

The manus and pes, like the inner surface of the limbs, are pale in colour. The tail is clothed with rufous brown hair which is of the same colour as that of the general dorsal body surface. The body and tail are spotted with white patches; but the spotting varies considerably in different specimens. For the most part the spots are confined to the sides of the body, the outer sides of the limbs, and the tail. Upon the face the spots are either small and inconspicuous, or else are entirely absent. Upon the body the spots are irregular in size and shape, and they vary from a mere dot to patches as large as a shilling. The presence of spots upon the tail distinguishes it at once from the smaller *D. viverrinus*. The tail is long, in most examples being about one sixth shorter than the total length of head and body. It is uniformly clothed with rather long harsh hairs. The ears are short, the inner surfaces are pubescent with short yellow hairs, and a tuft of pale hair covers the basal portion of the inner surface. The outer surface is clothed with hair of the general body colour. The rhinarium is dark flesh-coloured, granulated and cleft in the mid line. The eye is brown. The vibrissae are well developed, the mysticial set reaching upwards of 90mm. in length. All facial bristles present. Ulnar carpal and medial antibrachial sets well developed. The manus with naked palm and five well developed pads with small striated areas. Digital formula $3 > 4 > 2 > 5 > 1$. Claws strong and curved. The pes with naked sole, save posteriorily, where hair from the margins clothes the immediate neighbourhood of the heel. Hallux very small and clawless. Five prominent striated pads. Digital formula $3 > 4 > 2 > 5 > 1$. The pouch is shallow. The nipples are 6 in number, and are arranged in two crescentic lines.

FIGURE 30.—Left upper and right lower teeth of *Dasyurus maculatus*. Twice natural size.

The skull is powerfully built, and all the muscular ridges are highly developed (*see* Figure 49). In proportion to the general size of the skull, the brain case, as was pointed out in Figure 35, is remarkably small, though not so disproportionately so as in the Tasmanian Devil. The teeth are large and powerful (*see* Figure 50), and the distance from the front of the first molar to the back of the third molar measures 18mm. or more. The *bullae*, or swellings of the base of the skull beneath the bony cavity for the ear, are elongated, and they are about twice as long as they are broad; their characteristic features are shown in Figure 51. They differ markedly from the bullae of other members of the Genus.

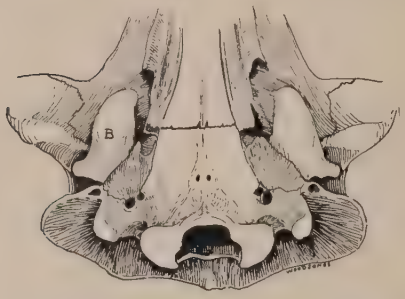


FIGURE 51.—Underside of the posterior end of the skull of *Dasyurus maculatus*. The Bulla on the left side of the figure is marked B. Natural size. Compare with Fig. 55.

DIMENSIONS.

	Ogilby's Catalogue. Skin. —	Queensland Mus. Skin. ♂	Brit. Mus. Cat. Skin. ♂	Waterhouse. Skin. ♂	Queensland Mus. Skin. ♂	Waterhouse. Skin. —
Head and body ...	·635	620	620	610	590	432
Tail	480	500	470	507	480	381
Hind foot	—	80	76	With claw, 89	80	With claw, 50
Ear	—	—	C. 24	28	—	25

DIMENSIONS OF SKULL.

	Australian Mus. Krefft. —	Tasmanian Specimen. —	Queensland Mus. ♂	Queensland Mus. —	Queensland Mus. —	Tasmanian Specimen. Brit. Mus. ♂	Queensland Mus. —	South Australian Specimen. —	Queensland Mus. ♂	Queensland Mus. ♂	Waterhouse. —	Queensland Mus. ♂	Queensland Specimen. Brit. Mus. ♀	Waterhouse. —	Queensland Mus. ♂
Basal length ..	115	109	108	107	105	104	101	98	94	93	88	86	84	– –	79
Breadth	– –	70	70	70	66	67	– –	64	57	57	53	– –	58	52	47
Nasals, length .	– –	41	– –	– –	– –	37	– –	35	– –	– –		– –	35	32	– –
Palate, length .	– –		59	58	58	54·5	57		52	55		51	51		49
Length of molar series	– –		24	23	23	– – –	22		23	23		23	– –		22

By Krefft the animal is described as being "not only very ferocious, but also exceedingly stubborn," and many accounts of its carnivorous habits, and its pluck as a fighter, are to be met with in works dealing with the earlier days of Australian colonisation. As would be imagined from its striated foot pads, and from the presence of the hallux, it is a tree-haunting species, and seems always to have been most numerous in the more wooded districts of the coast. Probably never abundant in South Australia, the stronghold of the species was in the south-eastern portion of the State. It is possible that some few still exist in the less closely settled areas of the South-East.

(2) Native cat. Common native cat.

DASYURUS VIVERRINUS (Shaw, 1800).

In form the animal is lithe and graceful; it is lightly built, and its whole appearance is that of an agile, active, predatory carnivore.

The fur is thick and soft. The under fur is dense and fine, and except where the coat is spotted with white it is dark slate coloured. The colour of the general body fur is olive grey, warming slightly towards the sides, and markedly towards the tail, to a yellowish or rufous grey. The dorsal surface has often a distinctly greenish tinge which becomes yellowish or ruddy towards the basal portion of the tail. The ventral surface of the body, and the inner sides of the limbs, are pale grey, yellowish, or white. The fur of the general body surface is irregularly spotted with white. Some 50 to 60 spots, ranging in size from mere specks of a few white hairs to irregular blotches about the size of a sixpence, are present on most specimens. The spotting is inconspicuous on the face and head; it is absent also from the free portions of the limbs, and the tail is invariably spotless.

The head and face are paler than the body, and are distinctly grizzled. The tail is markedly more rufous than the rest of the body, and the terminal tuft of hair is pale yellow or white. The manus and pes are white or pale yellowish grey.

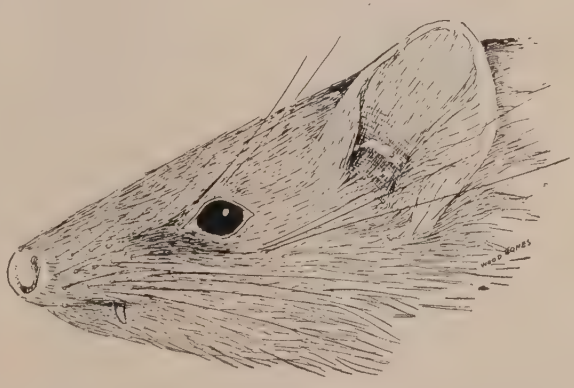


FIGURE 52.—Head of *Dasyurus viverrinus* from a male specimen. Natural size.

The tail is considerably shorter than the head and body; it is cylindrical and somewhat bushy in its basal portion, but towards the extremity the hair shows a very distinct tendency to form a dorsal crest. The ears are large, somewhat rounded in outline, and in the living animal they are carried folded. Fine white or pale yellow hairs clothe the backs of the ears and form a slight fringe on their margins. Within, the ears show a rim of fine hair round the edges, and a fine linear tract of hair along the line of folding. The processus antihelicis is large and broad, and presents a thick rounded margin. (*See* Figure 52.)

The rhinarium is naked, granular, and pink in colour in the living animal. It is cleft in its lower portion where it joins the upper lip. The eyes are fairly large. The iris is brown, the pupil circular. Eyelashes are well developed. The mysticial vibrissae are mostly dark in colour; they measure 60mm. as a maximum, and they are arranged in 6 rows. There are 2 or 3 strong dark supraorbital vibrissae, a tuft of about half a dozen long dark hairs in the genal set, a few pale submentals,

FIGURE 53.—Left manus and pes of *Dasyurus viverrinus*. Twice natural size.

and a cluster of 4 or 5 white interramals. The ulnar carpal vibrissae, 3 or 4 in number, are well developed, and are white or pale yellow in colour. A single medial antebrachial bristle is well marked in most specimens.

The palmar surface of the manus is naked, granular, and flesh-coloured. There are 5 well developed pads. The thenar pad is merged with the first interdigital, the 2nd, 3rd, and 4th interdigital, and the hypothenar pads complete the series. In the centre of each pad is a large smooth granulation; this central granulation shows no trace of striations. The claws are strong and sharp. The digital formula is $3 > 4 > 2 > 5 > 1$. (*See* Figure 53).

The sole of the pes is naked, granular, and flesh-coloured like the palm. There are 3 well developed pads with central unstriated granulations. A small pad marks the site of the absent 1st digit. The digital formula is $3 > 4 > 2 > 5$. (*See* Figure 53).

The pouch is somewhat shallow. The nipples are 6 in number, and are arranged in two crescentic rows.

The olive grey type, which is described above, is not the only colour variety of the species; for a melanistic form, in which the coat is black spotted with white; and a dark form, in which the body colour is brown spotted with white, occur in company with, and according to Gould, in the litters of the more ordinary type.

The skull is rather lightly built. (*See* Figure 54). The brain case is considerably larger in proportion to the size of the skull than in *D. maculatus*. The distance from the front of the first molar to the back of the third molar is about 14mm. The bullae are spherical and not elongated as they are in *D. maculatus*. (*See* Figure 55).

FIGURE 54.—Skull of *Dasyurus viverrinus*. Twice natural size. From a South Australian specimen.

DIMENSIONS.

	1. Ogibly.	2. Brit. Mus. ♂	3. Brit. Mus. ♀	4. Water-house.	5. N.S.W. ♂	6. Water-house.	7. S. Aus. ♂
Head and body	457	440	400	381	350	305	285
Tail	305	290	210	215	200	228	165
Hind foot	—	65	60	70	49	52	45
Ear	—	28	27	37	32	32	25

DIMENSIONS OF SKULL.

	Waterhouse.		Brit. Mus.	Waterhouse.		N.S.W.	South Australia.			
	♂	♀								
Length	79	75	75	74	73	72	64	58	56	55
Breadth	49	45	47	45	44	44	38	36	35	34
Length of nasals	32	28	31	26	25	29	23	20	20	19
Length of palate	46	41	45	41	41	41	36	35	33	32

From the absence of the hallux, and the granular surface of the palm and sole, we would imagine that *D. viverrinus* was by no means so strictly an arboreal animal as is *D. maculatus*. It was at home in a wide variety of habitats, and frequently took up its abode in the neighbourhood of human dwellings. It was abundant round, and even in the immediate precincts of, the larger Australian towns. Twenty years ago it was exceedingly common about Adelaide. Still more recently it lived close to Melbourne; and to-day it is not uncommon in the suburbs of Sydney. It inhabited treeless rocky country as well as the more cultivated

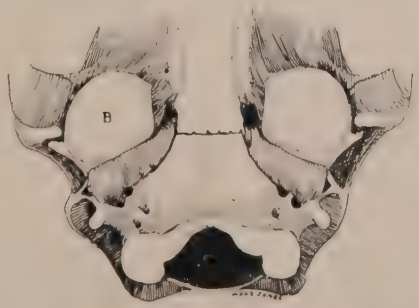


FIGURE 55. Underside of the posterior end of the skull of *Dasyurus viverrinus*. The Bulla on the left side of the figure is marked B. Twice natural size. Compare with Fig. 51.

districts, and everywhere evinced a preference for dwelling around homesteads and in the immediate neighbourhood of chicken runs. Very early in the days of colonisation it was regarded with dislike because of the damage it did by killing poultry; but there are many settlers who would now welcome its return in order to keep the mice plagues within check.

The Native Cat is an absolutely fearless animal, and one which possesses all the bold intelligence of the typical predatory carnivorous animal. It is an attractive creature in captivity, and is by no means difficult to handle and render familiar. Although it will kill and eat poultry, it is contented with far smaller game, and probably depends very largely upon insects as its main source of food. For the greater part of the day the animal sleeps with its ears folded down, and its activities commence only at dusk; then, after a cautious approach, it springs upon any victim with astonishing rapidity, and kills, as a rule, by a bite across the back of the head. There is no doubt that as a destroyer of mice, rats, and young rabbits the Native Cat played an extremely useful part in Australian rural economy, and despite the fact that it was an occasional robber of hen roosts its presence was a real asset to the country.

Its range in South Australia was formerly very wide. On Kangaroo Island it appears to have been always more or less of a rarity; but from the accounts of old wallaby trappers there seems to be no doubt as to its existence on the island. Since the snares set for the wallaby and the opossum are not particularly likely to capture a Dasyure, and as the animal's skin is of no commercial value, it is not impossible that its scarcity on the island is more apparent than real. By the South Australian Murray River natives it was known as Ng'rui Moch (many spots), and 30 years ago it haunted the shores of the river and lakes, being there very partial to a fish diet. To-day, if it exists at all in this State, it must be an animal of the utmost rarity. Although there is no doubt that the influences which have been at work in the general process of the extermination of the Australian fauna have operated to the full on the Native Cat; it is possible that another factor has come into play during the final scene of its passing. The animal has been trapped, poisoned and persecuted throughout the country; and yet if we turn to the case of the European weasel in New Zealand we may learn how little effect these means have on the extermination of an active and intelligent carnivore. The Native Cat, with its cunning and its activity, was well able to look after itself, despite the fact that it was an extremely easy animal to trap. Its rapid decrease started about the year 1900, and during that and the two following years the so-called "common" Native Cat practically disappeared from South Australia. Much the same thing happened in Victoria and in New South Wales, with the exception of the district immediately round Sydney. It would seem certain that some epidemic disease must have spread through the Dasyures, and that after a lapse of twenty years the remnant has not succeeded in re-establishing itself. In the Animal Protection Act of 1919 the Native Cat is not even mentioned. The evil or the good that it did has ceased to be a factor of any economic importance.

(3) Black-tailed, or Geoffroy's native cat.

DASYURUS GEOFFROYI (Gould, 1840)

In general size, form, and pelage very like the Common Native Cat; but distinguished by the less bushy tail, which becomes darker towards the tip, and by the presence of a small but distinct hallux. General colour olive grey with a tinge of rufous. Somewhat darker than *D. viverrinus*. The white spots are smaller and more numerous than in the typical *D. viverrinus*. Dorsal surface of the body, outer side of limbs and basal portion of the tail rufous grey, suffused with yellow, and pencilled with black. The chin, throat, underparts of the body and inner side of the limbs white. Face paler and greyer than the general body colour.

The tail is long, and not so bushy as in *D. viverrinus*, crested dorsally; its basal half dorsally, and fourth ventrally, coloured like the back; the end and the greater part of the ventral surface black. No spots are present on the tail. Ears large, the dorsal surface brown, but the edges both dorsally and ventrally white. The processus antihelicis is prominent. The rhinarium, eye, and vibrissae as in *D. viverrinus*.

Manus and pes brownish upon their dorsal surfaces. Manus with naked palms, granular. Pads as in *D. viverrinus*, without striations. Pes with a hallux some 5mm. in length, soles naked and granular. Pouch shallow. Nipples, 6 in number, in two crescentic rows. Skull in almost all features practically identical with that of *D. viverrinus*, but the two posterior palatal vacuities larger and more discreet.

DIMENSIONS.

	Brit. Mus. N.S.W.	Brit. Mus. Queensland.
	♂	♀
Head and body	400	360
Tail	310	270
Hind foot	63	60
Ear	31	31

DIMENSIONS OF SKULL.

	S.A. ♂	W.A. ♂	W.A. ♀
Length	65·5	77	63·5
Breadth	45	50	41
Palate, length	39	46	39·3
Nasals, length	23	27	25

How common the Black-tailed Native Cat used to be in South Australia is a point upon which evidence is difficult to gather. A specimen is recorded in the British Museum Catalogue of 1888 as from South Australia, collected and presented by Sir George Grey, and another was in Gould's collection from the Murray. In 1896 the animal was living in the Northern Territory as recorded by Sir Baldwin Spencer. No specimen from South Australia exists in the South Australian Museum, nor is any mention of a specimen included in the record books of that

institution. Moreover, men who have been professionally interested in the fauna of the State for a period of forty years are unaware of any examples being taken in South Australia proper. Unless it still lingers near to the northern limits of the State, it must probably be regarded as extinct in South Australia.

The form of the species which lives in Western Australia is larger and darker, and is properly known as *D. geoffroyi fortis*. Thomas, 1906.

Sub-Family II.—PHASCOGALINAE.

Division of the Sub-Family into Genera—

(A) Skull with the interorbital region broad and flat. Nasal bones expanded behind. Pes with striated pads at the bases of the digits. (*See* Figures 57 and 58).

(B) Hind feet with 5 digits.

C. Premaolars. $\frac{3-3}{3-3}$. Genus 1. *Phascogale.*

C^1. Premolars. $\frac{3-3}{2-2}$. Genus 2. *Chaetocercus.*

(B^1) Hind feet with 4 digits.

Genus 3. *Dasyuroides.*

(A^1) Skull with the interorbital region narrow and convex. Nasal bones not expanded behind. Pes with granulated pads at the bases of the digits. (*See* Figures 71 and 72).

(D) Hind feet with 5 digits. Bullae small. Genus 4. *Sminthopsis.*

(D^1) Hind feet with 4 digits. Bullae large. Genus 5. *Antechinomys.*

Genus 1. PHASCOGALE (Temminck, 1825).

This Genus contains a series of small animals, mostly of slender, graceful build; and generally not unlike the Tree Shrews and terrestrial Shrews among the Monodelphia. The rhinarium is naked and grooved. The ears are long and rounded. The tail is long; but it is variable in its characters. The feet are comparatively broad and short. The hallux is present, but is small and devoid of a claw. The palms and soles are naked, and granular in texture. The pads at the bases of the digits of both manus and pes are striated. The pouch is reduced or absent. Nipples rather variable in number, ranging from 4 to 10. Dentition I. $\frac{4-4}{3-3}$. C. $\frac{1-1}{1-1}$. PM. $\frac{3-3}{3\ 3}$. M. $\frac{4-4}{4\ 4}$. Carnivorous and insectivorous. Most species are capable of climbing, and some are semi-arboreal. The members of the Genus are known as a whole as Broad-footed Pouched Mice. Three species are recorded from South Australia.

KEY TO THE SOUTH AUSTRALIAN SPECIES.

I. External characters—

(A) Tail not crested. *Ph. flavipes.*

(A^1) Tail crested, ending in a terminal brush.

(B) General body colour and base of tail grey. *Ph. penicillata.*

(B^1) General body colour brownish, base of tail rufous. *Ph. calura.*

II. Cranial characters—

(A) Interterorbital breadth greater than width of muzzle opposite last premolar. *Ph. flavipes.*

(A^1) Interorbital constriction less than width of muzzle opposite last premolar.

(B) Basal length of skull about 40mm. *Ph. penicillata.*

(B^1) Base of skull about 30mm. *Ph. calura.*

(1) Yellow-footed Pouched Mouse.

PHASCOGALE FLAVIPES (Waterhouse, 1837).

A sturdy, compactly built, rather rough-coated little animal of a general warm russet colour. Though remarkably variable in size, it may be said that the average specimen is comparable to a half-grown rat. The animal living in the Mount Lofty range of South Australia is a large representative of the species.

The fur is dense and crisp, the coat having a roughish wiry appearance, the stiff hairs of the outer coat standing out prominently. The typical South Australian animal is dark grizzled brown on the dorsal surface, rich tan brown below. The head is broad and flat; in colour grizzled by the intermixture of black hairs and light brown hairs. In front of the eye is a darker patch, and immediately above and below the eye the light hairs prevail, making two light eye-lid patches. A light area also runs along the upper border of the mouth. The general dorsal surface is of a grizzled tawny brown; the grizzled appearance being due to the dark brown hairs having light tips. The longer harsh hairs of the back average 11mm. in length. Upon the sides of the body the colour becomes a rich golden tan, an especially bright patch being present immediately below and behind the

FIGURE 56.—Head of *Phascogale flavipes*. From a male specimen from Mount Lofty. One and a half times natural size.

ear. The chin and throat pale yellow. The whole of the ventral surface is bright tan, the bases of the ventral hairs being smoky grey. The outer surface of the limbs is like the general dorsal body colour, but more rufous ; the inner side of the limbs is pure bright tan, dorsal surface of manus and pes reddish yellow, being a paler shade of the colour of the ventral surface of the body.

The tail is shorter than the head and body. Uniformly clothed with stiff hairs, bright rufous on the ventral surface at the base, and on the dorsal surface coloured like the body ; becoming darker on all aspects towards the tip.

The ears are short ; when laid forwards they only just reach the posterior angle of the eye (thereby differing from the description in the Brit. Mus. Cat., 1888):

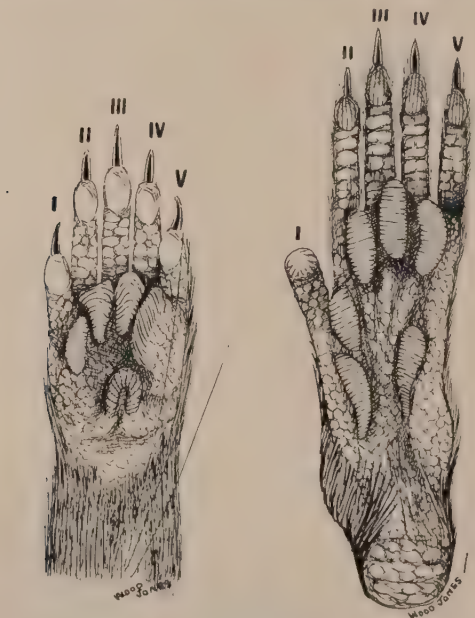


FIGURE 57.—Left manus and pes of *Phascogale flavipes*.
Four times natural size.

almost naked upon the dorsal surface, save for some fine short hairs along the anterior margin ; the naked portion being covered by a tuft of hairs growing from the base. Within, are short fine hairs most prominent around the margins, and along the line on which the concha is folded during rest. The posterior margin is sinuous, being markedly concave opposite the line of folding. The processus antihelicis is large, rounded, and flat. (*See* Figure 56).

The rhinarium is naked, dark flesh-coloured and granular. It is cleft in its entire length. The eye is black, the eyelids being fringed by fine black hairs. The vibrissae are well developed. All the usual facial groups are present, and well represented. Many of the longer vibrissae are black at the base and pale towards

the tip. Those of the mysticial set measure 25mm. Upon the fore limb, the ulnar carpal and the medial antebrachial are well developed and pale.

The manus shows a naked granular palm, with the typical striated pads, the thenar and the first interdigital pads being conjoined. The digital formula is $3 > 4 > 2 > 5 > 1$. (*See* Figure 57).

The sole of the pes is naked, save for some hairs which come beneath the fore part of the heel. There are six well developed pads, all striated. The digital formula is $3 > 4 > 2 > 5 > 1$. The hallux is clawless. (*See* Figure 57).

The skull (*see* Figure 58) in general form is broad and flat. The nasal bones are broadened at their posterior ends. The inter-orbital region is broad, smooth, and flat. The bullae are rounded, tympanic inflation well marked. The interorbital constriction is equal to or greater than the diameter of the snout at the level of the last premolar.

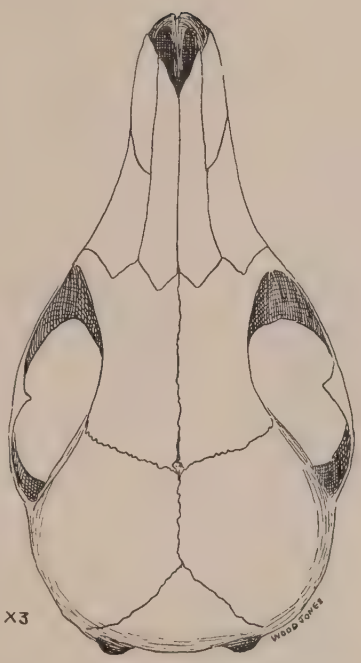


FIGURE 58.—Skull of *Phascogale flavipes* seen from above. Three times natural size.

DIMENSIONS.

	Mount Lofty.	Mount Lofty.	Mount Lofty.	Skin Brit. Mus. S.A.	Brit. Mus. S.A.
	♂	♂	♂	♂	♀
Head and body	148	144	140	c. 130	108
Tail	94	92	93	90	84
Hind foot	20	19	20	19	17
Ear	10 (15·5)	15 (19)	12 (17)	10	10·5

DIMENSIONS OF SKULL.

	Brit. Mus.	Humbug Scrub. S.A.
	♀	♂
Basal length	27	26
Breadth	16	16
Nasals, length	12	10
Intertemporal breadth	6·5	6·5
Palate, length	15·8	15
$M^1 — M^3$	5·5	5·8

The Yellow-footed Pouched Mouse is an animal of great interest from a zoological point of view, since in the whole of its anatomy it shows itself to be a remarkably generalised animal. It represents a marsupial base form, its general anatomy being but little modified from a basal mammalian plan, and it stereotypes the simple creature that could be considered ancestral to most of the marsupial radiations.

FIGURE 59.—Left upper and right lower teeth of *Phascogale flavipes*. Six times natural size.

Though very rarely seen, it is probably still fairly abundant in suitable localities. It is a bush-haunting species. A useful insectivorous and carnivorous creature, it is too small and obscure in its ways to attract attention; and but for being occasionally brought into houses by cats it would usually escape notice. It lives at the present time in the Mount Lofty range; but it is much to be feared that cats will exterminate it wherever these destructive pets are free to work havoc among the native fauna. A form named *Phascogale flavipes leucogaster*, in which the ventral surface is white instead of tan, is found in North and Western Australia.

(2) **Brush-tailed Pouched Mouse.**

PHASCOGALE PENICILLATA (Shaw, 1800).

This species appears never to have had a popular name, although to a passing generation it was fairly familiar animal; in works on zoology it is usually termed the Brush-tailed Pouched Mouse.

One of the most beautiful of the little carnivorous Marsupials; its general appearance is that of a small, lightly built, grey rat; with a long tail terminating in a full silky black brush. (*See* Figure 60).

Though lightly built, and extremely graceful, it evinces strength and activity in every line of its lithe body.

The fur is fine and soft, the under-fur thick and dense. The long hairs of the outer coat of the dorsal surface are 20mm. in length. The general body colour is pale grizzled grey inclining to a more rufous grey upon the outer aspect of the fore limbs. The head, the general dorsal surface of the body, the outer surface of the limbs, and the base of the tail uniformly grizzled grey. Fore limbs somewhat more rufous than the general surface of the body. The chin, throat, ventral surface of the body and inner aspect of limbs passing from pale grey to creamy white. The dorsum of manus and pes grey, becoming white upon the digits. Crown of head

FIGURE 60.—*Phascogale penicillata.* From an adult male South Australian specimen. Half natural size.

grizzled grey, distinctly darker in the mid line. A darker patch extends through the mysticial region to the eye, and beyond the eye to the ear; the immediate area above and below the eye is distinctly lighter than the general colour of the rest of the head and face. (*See* Figure 61).

The tail is long, its basal fifth is clothed in the whole of its circumference with fur of the general body colour and texture. The next portion, again amounting to about a fifth, is short haired; the hair upon the dorsal surface being cream grey and considerably lighter than the dorsal surface of the body; the ventral surface

is clothed with chocolate brown hairs which are continued further towards the tip of the tail as a narrow median crest. The terminal three-fifths consist of a beautiful silky brush of black shining hairs; the hair being uniformly distributed around its circumference. The terminal tuft extends 30mm. beyond the tip of the tail, and the long hairs of the fullest portion of the brush measure 40mm. The ears are large, laid forward they cover the eyes. They are thin and membraneous and almost naked; very fine pale hairs are distributed along their margins and along the inner surface over the line where the concha is folded during repose. The processus antihelicis is prominent. The rhinarium is naked, granular, dark flesh-coloured, and grooved in the whole of its extent. The eye is dark brown fringed by a row of short fine black eyelashes. The mysticial set of vibrissae is disposed in 5 or 6 rows; the individual hairs are fine, black in colour and the longest are 40mm. in length. Two black hairs spring from the supraorbital papilla, one of these is 20mm. long, and the other only a little more than half that length. The genal tuft contains both light and dark vibrissae of which there are 6 or 8, the longest measuring 45mm. The submental group is not well defined, and consists of short pale hairs increasing in length posteriorly, till they merge with the interramal set which consists of 2 or 3 white bristles. The ulnar carpal set is particularly well marked, and contains 6 or 8 strong white vibrissae 30mm. in length. There are 2 well developed anconeal vibrissae 20mm. long and white in colour.

FIGURE 61.—*Phascogale penicillata*. Characters of the head from a male specimen taken in the Mount Lofty Range. Natural size.

FIGURE 62.—*Phascogale penicillata*. Skull of a male South Australian specimen. Twice natural size.

Manus: with the palms naked, granular, and flesh-coloured. The digital formula is $3 > 2 > 4 > 5 > 1$. Apical pads are well developed. Four well developed elongated interdigital pads, which are finely striated. Thenar and 1st

interdigital pad partly confluent. Hypothenar pad large, striated and crescentic in outline. Pes hairy beneath heel, rest of sole naked, granular, flesh-coloured. Digital formula—$3 = 4 > 2 > 5 > 1$. Hallux clawless. Three elongated, striated, interdigital pads. Thenar and first interdigital pads conjoined. Hypothenar pad elongated ; finely striated. All digits but the hallux armed with strong curved claws. Hair is continued to the termination of digits.

Pouch but little developed, but the area of the marsupium marked by light tipped brown hairs of a texture different from that of the general body hair. Nipples 10.

Skull stoutly built, with a flattened brain case and a short conical muzzle (*see* Figure 62). Interorbital constriction considerably less than the diameter of the muzzle at the level of the last premolar.

Bullae rounded ; tympanic inflation well marked.

DIMENSIONS.

	Brit. Mus. West. Aust. ♂ Adult.	Mount Lofty. ♂ Adult.	Mount Lofty. ♂ Adult.
Head and body	240	210	210
Tail	225	200	200
Hind foot	42	36	36
Ear	24	24	25

DIMENSIONS OF SKULL.

	Brit. Mus. South Aust. ♀ Adult.	Mount Lofty. ♂ Adult.
Basal length	45	43
Breadth	29	29
Nasals, length	17·3	17
Intertemporal breadth	8·3	8·5
Palate, length	26	25
$M^1 - M^3$	9·2	10

Though once a familiar animal to settlers whose homes were in the more wooded districts, *P. penicillata* is unknown to the rising generation of country people. In habit it was predominently a bush-haunting species ; an active climber with the reputation for singular blood-thirstiness. It seems astonishing that so small an animal could ever have been a real menace to the poultry run of the settler, and yet it is credited with being a determined slayer of chickens, and one which killed not merely to appease its appetite. Many of the older residents in South Australia have caught the animal red-handed, and as with the Native Cat, it seems a remarkable thing that so well equipped a carnivore should have been reduced to a condition bordering on extinction in so comparatively short a time. What its range within the State may have been is difficult to determine. It was not met with by the Horn Expedition, but an animal which answers very much to its description, but of which no specimen is available, apparently exists over a wide area in the Centre. By the South Australian Murray River natives it was well known under the name of " Pundi " but it has not been seen in their district for very many years.

(3) Lesser Brush-tailed Pouched Mouse.

PHASCOGALE CALURA (Gould, 1844).

In general build resembling *Ph. penicillata*, but considerably smaller. Fur soft and fine, nearly wholly composed of under-fur. General colour a delicate, but warm ashy grey. Head greyish; back of body and outer side of limbs rufous grey, the rufous tinge increasing towards the sides of the body. Chin, throat, chest, ventral surface of the body and inner side of the limbs white; the line of demarcation between the ventral and the dorsal colouration being fairly distinct. Ears large, almost naked; the naked portion being partly concealed by tufts of rough hair springing from the base. Manus and pes white. Tail long. The basal portion clothed by short bright rufous hairs above, and below being dark brown. The terminal half clothed with a uniform black brush, the brush being somewhat less developed than in *Ph. penicillata*. Soles and palms naked. Pads well developed and striated. Skull as in *Ph. penicillata*, but smaller.

DIMENSIONS.

	Brit. Mus. From Adelaide.	Alice Springs.
	♂	♂
Head and body	c. 125	135
Tail	147	147
Hind foot	24	24
Ear	20	23

DIMENSIONS OF SKULL.

Basal length	29·6
Breadth	19·5
Nasals, length	9·6
Intertemporal	6·8
Palate, length	17
$M^1 - M^3$	6·3

The measurements given in the British Museum Catalogue of 1888 are taken from an Adelaide specimen, but I have failed to trace any recent records of the animal in South Australia. In 1896 Mr. Gillen captured one at Alice Springs, and Sir Baldwin Spencer noted at the time that it was "evidently not a common form in the central districts." To-day it is impossible to define its former range in the State, or, unfortunately, even to attest to its present existence.

GENUS 2. CHAETOCERCUS (Krefft, 1866).

The pouched mice included in this Genus are terrestrial forms, which live in a typical desert habitat. They are small robustly built animals with shorter muzzles, shorter limbs, and shorter ears than the more arboreal members of the genus *Phascogale*. The tail is crested on its dorsal surface. Striations on the pads are reduced and are present only on the pes, the pads of the manus being smooth. Dentition—$I\ \frac{4-4}{3-3}$. C. $\frac{1}{1}$. P.M. $\frac{3-3 \text{ or } 2-2}{2-2}$. M. $\frac{4-4}{4-4}$.

The last upper premolar is single rooted and very small; it is very commonly entirely wanting.

There are only two members of the Genus, and both are recorded in the fauna of South Australia. The two species differ only in their coat colour :—

(A) Dark form; the original species described by Krefft. *C. cristicauda.*

(A[1]) Pale form; named by Oldfield Thomas. *C. hillieri.*

(1) Crest-tailed Pouched Mouse. Krefft's Pouched Mouse.

CHAETOCERCUS CRISTICAUDA (Krefft, 1866).

By the natives about Ooldea Soak named "Mulgara," and to the natives of Charlotte Waters known as "Amperta."

FIGURE 63.—*Chaetocercus cristicauda.* From a female specimen. Three-quarters natural size.

A sturdily built, short limbed, compact little animal. The head is somewhat flat, and the muzzle is more blunted than in most of its allies. The coat is fine and soft, mostly consisting of under-fur, which on the dorsal surface is slate grey at the base and bright brown at the tips. General colour varying from soft buff to bright red brown, becoming warmer and brighter upon the back. Hairs of the mid dorsal region measuring 10mm. Face light brown, brighter round the eyes and along

the upper lip. Outer side of limbs sandy coloured. Chin, throat, ventral surface of the body and inner side of the limbs creamy white or pure white. Manus and pes white.

Tail shorter than the head and body; it is thickened, the thickening starting almost at the base, and extending for some two-thirds of the total length of the tail. Root of the tail clothed by a continuation of the red-brown body hairs. Immediately following this basal portion of the tail, the proximal, and swollen, portion is clothed by short, closely adpressed hair of a bright fox red colour. The terminal tapering half of the tail is ornamented with a large dorsal, and a small ventral crest of shining black hairs. The ventral crest is inconspicuous, and consists of short stiff hairs which do not increase in length as they are followed towards the tip of the tail. The dorsal crest consists of long hairs which, starting as a mere ridge of fine black hairs, increases in length towards the tip of the tail and constitutes a fine fin-like crest.

FIGURE 64.—*Chaetocercus cristicauda.* Head of a male specimen viewed from above. Three-quarters natural size.

The ears stand well away from the head and are rounded in outline. In colour they are slightly paler than the general body tint. The outer surface is clothed by fine creamy or sandy hairs. When the ear is laid forward it fails to reach the posterior angle of the eye. There is a single processus antihelicis.

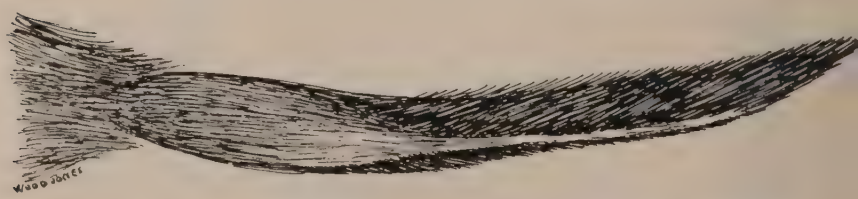


FIGURE 65.—*Chaetocercus cristicauda.* Lateral view of the crested tail. Natural size.

The muzzle is not so pointed as in the other Pouched Mice. The naked rhinarium is finely granular in texture, and pale brown in colour. It is deeply cleft in the mid line, the cleft being continued to the upper lip, and to the dorsal surface of the naked area. The nostril is cleft laterally.

The eye is surrounded by a pale area of hair. The eyelashes are dark, and better developed upon the upper than upon the lower lid. The eye is black and rather large.

There are four rows of mystacial vibrissae: the individual hairs are black, but, when elongated, the tip is pale: the longest measure 33mm. The supraorbital

set contains only 1 or 2 short dark bristles. From 4 to 6 long pale vibrissae spring from the genal tubercle. The submental set is represented by a few pale hairs, and 3 long white vibrissae spring from the interramal papilla. The ulnar carpal vibrissae are well marked, and 2 long (18mm.) and 2 short bristles are present.

The palms of the manus are naked, granular, and almost white in colour. There are 5 well-developed pads and a sixth (proximo-radial) less distinct. The pads are granular. Each pad has a central specialised granule (not so well marked in the proximo-radial pad) which marks the contact point of the pad, and which is surrounded by the smaller uniform granulations of the palm. The central granules

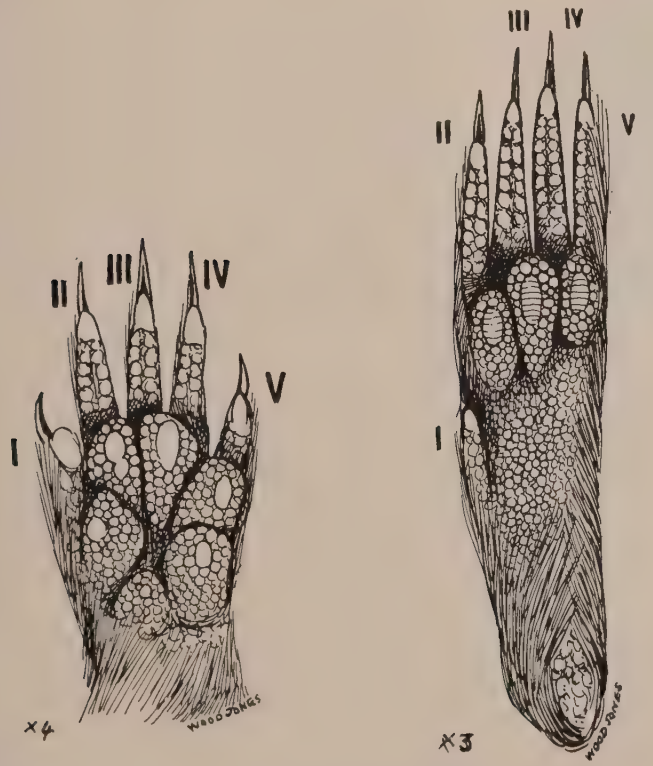


FIGURE 66.—*Chaetocercus cristicauda.* Left manus and pes. Manus four times, pes three times, natural size.

are plain; there being no striations or punctures upon them. The digital formula is $3 > 4 > 2 > 5 > 1$; digits 2 and 4 being almost equal. Apical pads are present on the digits and they are unstriated.

The soles of the feet are naked in their anterior portion and hairy towards the heel. The naked portion is granular. There are three well developed pads. Each

pad is granular; but, as in the palm, there is a definite central area marked out on the pad. In the sole this central area is sculptured by fine transverse striae. This species has always been described as being distinguished by having unstriated pads, but no specimen that I have examined has failed to show the presence of definite striations on the pads of the sole (*see* Figure 66). The digital formula is $4 > 3 > 5 > 2 > 1$; digits 3 and 5 being almost equal. The hallux is small, but remarkably variable in its degree of development, and possesses no claw. Apical pads are unstriated. The pouch in the quiescent state is practically obsolete. Nipples from 6 to 8.

FIGURE 67.—Upper left and lower right teeth of *Chaetocercus cristicauda*. Four times natural size. The small upper third premolar (P.M) is present in this specimen. In some specimens the first premolar is equally reduced.

The skull is stoutly built, being broad and flat in general contour. The bullae are large and rounded, mastoid inflation being particularly well marked. The upper central incisor does not project forward: it is separated by about its own diameter from the tooth next behind it. The last upper premolar when present is a minute tooth (*see* Figure 67). The first upper premolar is also at times reduced to a mere rudiment.

DIMENSIONS OF SKULL.

	Spencer.	Ooldea.
	♀	♂
Basal length	34·5	35
Breadth	23·5	24
Nasals, length	12	12
Palate, length	18	18
$M^1 - M^3$	7·5	8

The size to which the animal grows is extremely variable, a condition which is familiar in several of the small species living in the Centre. But apart from the general size, the actual proportions of different parts of the body manifest a strange variability in different individuals, an extended series of measurements is therefore appended; the first from Sir Baldwin Spencer's specimens from Charlotte Waters; the second from my own from Ooldea, where they were collected by Mr. A. G. Bolam. [NOTE.—The method of measuring the ear is different in the two series.]

	Sex of Specimen.	Head and Body.	Tail.	Hind Foot.	Ear.
1	♂	220	126	35	18
2	♀	170	98	30·5	16
3	♀	168	110	30·5	17
4	♂	148	89	26	15·5
5	♂	144	93	28	15
6	♀	138	86	25	13·5
7	♂	136	83	27	14
8	♀	135	86	26	15
9	♀	135	88	26	18 ?
10	♀	135	84	27	17
11	♀	132	85	25	14·7
12	♀	130	85	28	15·5
13	♀	130	85	26	14
14	♀	130	86	26	15
15	♀	128	89	27	14·5
16	♀	125	93	26	14
17	♂ Not adult	91	67	22·5	15
18	♀	86	51	20·5	12
1	♂	180	92	31	25
2	♂	180	80	27	21
3	♂	170	102	30	24
4	♂	170	85	28	20
5	♀ With 7 embryos	160	93	26	20
6	♂	155	100	29	23
7	♀	155	75	25	18
8	♀ With 7 embryos	150	84	27	20·5
9	♀	130	82	23	28
10	♂	125	74	24	15

Krefft's Pouched Mouse has an interesting history. It was originally described in 1866 from a South Australian specimen which was preserved in the Australian Museum, Sydney. The original specimen was in very poor condition, and several details of importance were lacking, or given inaccurately, in the first published description. Thirty years passed before fresh specimens were examined, and then, in 1896, the animal was again brought to light by the Horn Expedition, and an extended description of the species was given by Sir Baldwin Spencer. It is a typical desert animal, one which is well known to the blacks, and probably not uncommon in good seasons in the Centre. Like all the fauna of the Centre its numbers are subject to the most remarkable fluctuations; and so also is the size at which it attains maturity. It is the animal which on several occasions has multiplied in an astonishing manner during the passage of a mouse plague across Central Australia. At these times its services are of the greatest value, and in the mouse plague of 1905, although no human ingenuity could check the increase of the mice, the appearance of these active little carnivores cleared them from certain districts in a remarkably short time.

The Mulgara is an absolutely fearless animal, and beyond doubt it is one of the most intelligent of the marsupials. Those that I have had in captivity have shown the most trusting boldness: they will come confidently to the hand, and although for their size one of the most efficient carnivorous forms, they make no attempt to bite unless molested. They will thrust their noses against the wire of their run right into a cat's face, and this through no stupidity on their part, for both by vision and by scent they are perpetually well informed of their surroundings. A large

and active mouse introduced into the cage of a Mulgara is killed in a flash if the animal is hungry ; but if its appetite is appeased it will freely allow the mouse to occupy its bed until such time as it requires a meal. When hungry, its methods of mouse hunting are remarkable. Regarding its victim for a second, the whole animal becomes rigid, its tail quivers in true lizard fashion, and with a lightening stroke it seizes the mouse across the back of the head and, practically with the stroke, the mouse is dead.

Despite cramped quarters and strangeness of surroundings, I have never seen the Mulgara bungle the business : one rush, one stroke delivered in a flash, a bull-dog hold and thing is over. After this remarkable exhibition of precision in killing the Mulgara usually attends to its toilet before proceeding further ; for in all things it is a remarkably dainty and clean little animal.

The operation of eating a mouse is carried out in a most methodical manner. The start is always made with the tip of the nose. The skin is separated and turned back. The skull is crushed, the brain devoured, and the body is eaten from head to tail, often without the production of a single laceration of the skin. A rat which provided a meal for three hungry Mulgaras was skinned almost as neatly as though a skilled taxidermist had been at the work. No bones were left attached to the hands and feet, the skin was turned completely inside out and was practically perfect.

Although a mouse or a bird is always killed in a lightning rush, considerable caution is displayed in dealing with certain beetles, and it is a remarkable thing that all insects that are not instantly recognised, and killed by biting, are taken in the hand before being transferred to the mouth. Most bettles are caught in the hand, and the utility of the manus for searching out and picking up insects which cannot be seized by the jaws is truly remarkable. Although such bloodthirsty little animals, they do not quarrel among themselves, and they may be placed together in a cage regardless of sex or acquaintance ; in this respect they differ remarkably from several less carnivorous marsupials. They will not kill a sickly fellow, nor will they devour its body when dead ; but they vacate the nest in which a dying comrade is lying, and do not molest it in any way. They appear to be extremely affectionate little animals, and they are fond of lying in the sun with their heads on each others backs. They are by no means nocturnal, being lovers of the sunlight, and having a truly lizard-like habit of lying perfectly flat in the hot sunshine. The degree of heat and the intensity of sunlight they delight in is very astonishing in a mammal. Particularly reptilian is their method of flattening their bodies whilst basking, and so too are the rapid quivering of the tail, and the short sharp movements of the limbs as the animal exposes itself to the direct rays of the sun. There is also something remarkably reptilian in their vitality. Those that I have had for long in captivity have all arrived from the Centre in a condition which could fairly be described as "dead." All were cold and apparently lifeless after their long winter railway journey from Ooldea ; but these apparently dead animals have proved easy to resuscitate by heat and artificial respiration.

The breeding season (at Ooldea) is from June to September, and seven seems to be the usual litter. The pouch is practically absent ; but when the embryos are small they are more or less protected by a shallow ridge of integument which

marks the sides of the pouch area. When the young have grown larger they depend from the nipples unprotected by any skin fold of the mother's ventral surface. It is a curious thing to see a mother, with seven large foetuses clinging to the nipples, staggering about in search of insects or in combat with mice. The time spent by the young on the nipples is considerably over a month. The animal appears to have a wide distribution in the Centre, and although like most carnivores it is not usually at all abundant it is capable of rapid increase during good seasons. For all my specimens, living and dead, I am indebted to Mr. A. G. Bolam, of Ooldea.

(2) Hillier's Pouched Mouse.

CHAETOCERCUS HILLIERI (Thomas, 1905).

This species was described from a single skin (without skull) from Killalpaninna : it was named after its discoverer, Mr. H. J. Hillier, an authority on the Aranda natives. The specimen differs from *C. cristicauda* in being considerably paler in colour. It must be pointed out that *C. cristicauda* is a very variable animal, and specimens which are considerably lighter than usual are often captured with the more normal coloured individuals.

DIMENSIONS OF THE TYPE SPECIMEN (♂).

Head and body	150
Tail	100
Hind foot	30
Ear	27

Unless further specimens from Cooper's Creek should show this type to be constant, with perhaps some cranial distinctions, we might be disposed to regard it as merely a pale variety of the older species.

GENUS 3. DASYUROIDES, (Spencer, 1896).

This Genus was created for the reception of one of the most interesting animals discovered by the Horn Expedition to Central Australia. The generic characters present a strange mingling of features distinctive of nearly allied Genera.

The general form of the body closely resembles *Chaetocercus* ; the same sturdy short-limbed build characterises both animals, and their general similarity is striking.

The pes has only four digits, and in the absence of the hallux an approximation is made to some of the members of the Genus *Dasyurus*. The soles of the feet are hairy, and in this feature there is a resemblance to some of the Narrow-footed Pouched Mice of the Genus *Sminthopsis*.

The marsupium is shallow, and the nipples are 6 in number. The skull in general is as in the Genus *Phascogale*, but the nasal bones are only very slightly expanded behind and thereby resemble those of *Sminthopsis*.

The dentition is I. $\frac{4-4}{3-3}$. C. $\frac{1}{1}\cdot\frac{1}{1}$. P.M. $\frac{3-3}{2-2}$. M. $\frac{4-4}{4-4}$; in this respect resembling *Chaetocercus*.

The animals are desert living creatures, dwelling in burrows on the stony tablelands. Nocturnal in activity ; carnivorous and insectivorous.

Byrne's Pouched Mouse.

DASYUROIDES BYRNEI (Spencer, 1896).

Named after Mr. P. M. Byrne, of Charlotte Waters, who obtained the original specimens.

Form, stout and strong; fur, close and soft, mainly composed of under-fur. General colour a grizzled grey, with a faint rufous tinge, especially on the head and back. Chin, ventral surface, inner side of limbs and upper surface of manus and pes white. Tail rufous coloured in rather less than its basal half, the hair being fairly long. The terminal half is thickly covered all round with long black hairs, which form a very well marked dorsal and ventral crest. The tail is fairly thick, but not incrassated.

The ulnar carpal vibrissae are well developed; 5 or 6 in number, the longest measuring 42mm. Ears naked above. Laid forward they reach nearly to the front of the eye.

Manus with naked palms: 5 well marked and faintly striated pads on granular elevations. Pes with comparatively narrow soles. The median part of the sole naked and granular, a close set series of hairs directed towards the mid line covers each side of the sole.

Pouch very slightly developed, marked by two low lateral folds. Nipples 6.

Skull somewhat strongly built. Muzzle short and broad. Nasals very slightly expanded posteriorly. Interorbital space fairly broad. Bullae very large and rounded, their mastoid portion much inflated.

DIMENSIONS (Spencer).

	♂	♂	♀	♂	♂	♂
Head and body	182	175	175	170	166	165
Tail	130	138	132	134	131	140
Hind foot	38	37	37	37	38	38
Ear	18	21	20	23	21	20

DIMENSIONS OF SKULL.

Basal length	37·2
Breadth	24·2
Nasals, length	13·5
Intertemporal	8
Palate, length	21
$M^1 - M^3$	9

Obtained from Charlotte Waters. The above account is taken mainly from Sir Baldwin Spencer's description of the animal.

At Killalpaninna, on Cooper's Creek, a rather smaller and paler variety occurs, and this form has been distinguished by Oldfield Thomas (1906) as *Dasyuroides byrnei pallidor*.

GENUS 4. SMINTHOPSIS (Thomas, 1887).

In this Genus are included certain little animals usually known as Pouched Mice, which differ from the Pouched Mice included in the three preceding Genera mainly in possessing feet which are longer and narrower, and upon the soles of which are granular, not striated, pads. They are mostly slender and delicately built little

animals of a general shrew-like aspect. The ears are large and rounded. The rhinarium is naked, finely granular and deeply cleft in the mid line. The tail is well developed and short-haired. The pouch is more developed than in the Broad-footed Pouched Mice of the Genus *Phascogale*. Nipples 8–10. Dentition I. $\frac{4-4}{3-3}$; C. $\frac{1}{1}$; P.M. $\frac{3-3}{3-3}$; M. $\frac{4-4}{4-4}$.

The Narrow-footed Pouched Mice, as their long feet and granular pads suggest, are terrestrial animals. They are mostly nocturnal in activity and insectivorous in diet. The Genus is represented by several species which seem to show much variability and which are therefore by no means easy to determine.

Probably at least four species live in South Australia; but a great deal more work must be done in the way of systematic collecting in the Centre before any certainty regarding the distribution of these little animals is arrived at. Two of the species included here have been taken at Charlotte Waters, but almost certainly their range extends into South Australia proper. Species, such as *S. psammophilus*, which have not yet been recorded further south than the Lake Amadeus region are not included here.

KEY TO THE SOUTH AUSTRALIAN SPECIES.

(A) Tail variably incrassated at the base.
  (B) Pes with definite pads, hairy only under the heel.
    (C) Tail shorter than the head and body. *S. crassicaudata.*
    (C^1) Tail longer than the head and body. *S. larapinta.*
  (B^1) Pes without definite pads, hairy throughout. *S. hirtipes.*
(A^1) Tail not incrassated at base. *S. murina.*

(1) Fat-tailed Pouched Mouse.

SMINTHOPSIS CRASSICAUDATA (Gould, 1844).

A very small mouse-like creature. A savage and alert-looking little animal with

FIGURE 68.—*Sminthopsis crassicaudata*. Adult female specimen. Natural size.

a general resemblance to the shrews of the Northern Hemisphere. Tail notably thickened (*see* Figure 68). Fur fine and soft, almost entirely composed of underfur. General colour grizzled grey, becoming browner on the back. Individual hairs slate grey at the base and brown at the tip. Dorsal surface of the muzzle and face paler than the body. A variably marked dark stripe runs along the muzzle and passes through the region of the eye towards the ear (*see* Figure 69). Above and below this line, the face is rather more yellowish brown than the general body colour. Tail a uniform greyish, paler than the body. Chin, chest, and ventral surface greyish white. Manus and pes white.

FIGURE 69.—*Sminthopsis crassicaudata.* Head of an adult female South Australian specimen. Twice natural size.

Tail shorter than the head and body; thickened, the maximum girth of the thickened portion being somewhere near the middle of the length of the tail, tapering both towards the base and the tip. The degree of thickening, and the total length of the tail are subject to wide variation.

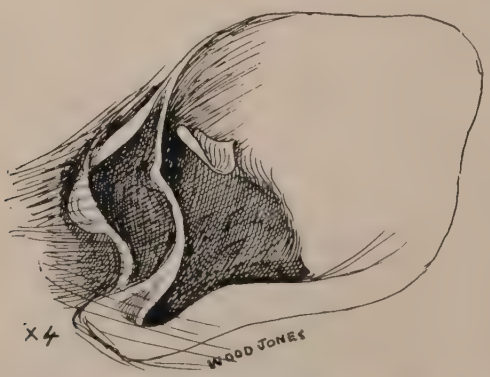


FIGURE 70.—*Sminthopsis crassicaudata.* Left ear. Four times natural size.

The tail is covered with fine scales and clothed with short, stiff, pale hairs. Ears very large and pointed. Laid forwards they reach at least half way between the tip of the snout and the eye. Inner surface with only a few pale hairs along the

margins. Margins of ear pigmented, and darker than central portion. Outer surface of ear very boldly marked; anterior portion pigmented, and clothed with fine short brown hairs; central portion yellowish and practically naked; hinder portion slate grey, and giving rise only to pale fine short hairs. A tuft of long hair is present at the base of the central yellow portion of the dorsal surface of the ear. Processus antihelicis is large and only partially folded (*see* Figure 70). Muzzle sharply pointed. Rhinarium dark flesh-coloured; granular; deeply grooved below. Nostrils cleft at their lateral margins. Eyelashes fine and dark; the eye

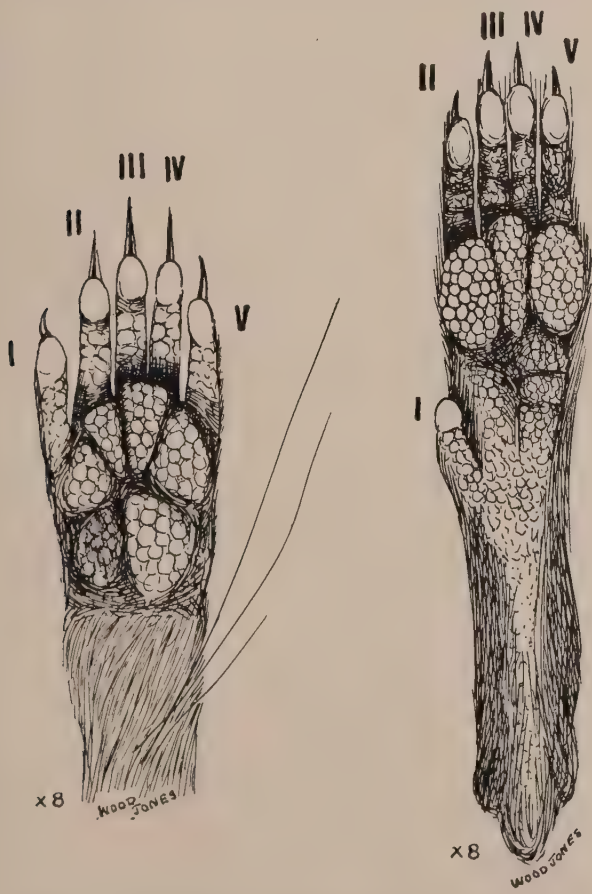


FIGURE 71.—*Sminthopsis crassicaudata.* Left manus and pes. Eight times natural size.

is black; the pupil circular. There are four rows of mysticial vibrissae; two (one long and one short) supraorbital; one long genal; and four short interramal.

All the facial vibrissae are dark in colour. There are two or three long pale ulnar carpal vibrissae.

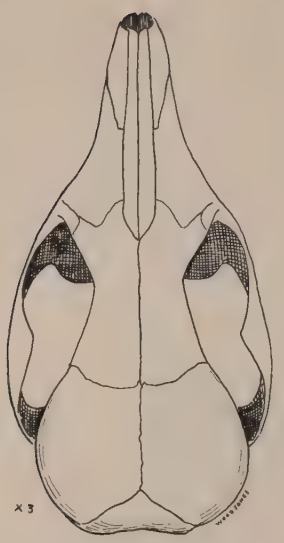


FIGURE 72.—Skull of *Sminthopsis crassicaudata* seen from above. Three times natural size.

The manus with naked, granular, flesh-coloured palms. Five well-developed granular pads, and a sixth (proximo-radial) less distinct.

Digital formula 3 > 4 > 2 > 5 > 1; digits 3 and 4 being almost equally prolonged. Apical pads present on all digits, unstriated.

Pes with soles naked in mid line over almost the whole of their extent; hairy at the sides and around the heel. Soles granular, flesh-coloured. Three well developed granular pads at the bases of digits 2, 3, 4, and 5. No hallucal pad. Digital formula 4 > 3 > 5 > 2 > 1. Hallux small and clawless. Apical pads present, unstriated. (*See* Figure 71).

Pouch well-developed, nipples varying from 6 to 10.

Skull very lightly and delicately built. The interorbital constriction narrow. The nasal bones unexpanded at their posterior ends. (*See* Figure 72).

DIMENSIONS.

As this little animal is exceedingly variable in size and proportions an extended series of measurements is given. It may be said in general that the form of the species living in the southern portion of the State is a large, long eared, short-tailed type, with feet considerably less hairy than is usual in specimens from the more arid districts.

	The Adelaide. District.		The North-East.		The North-West.
	♀, 6 young.	♂	♀, 5 young.	♀	♀, 6 young.
Head and body	110	100	85	66	90
Tail	58	47	60	55	60
Hind foot	15	15	15	15	14
Ear	23	19	15	14	17

	The Centre (Baldwin Spencer).						Queensland. (Brit. Mus.)	Victoria. (Brit. Mus.)
	♀	♀	♀	♀	♂	♀	♀	♂
Head and body ..	91	89	85	84	82	80	75	85
Tail	73	56	69	71·5	75	73	52	53
Hind foot	15	15·5	16	15·5	15·5	15·5	14·5	14·6
Ear	19	15·5	16	14·5	17	14·5	12·5	14

DIMENSIONS OF SKULL.

	N.S.W. Brit. Mus.	Brit. Mus.	South Aust.
		♀	♀
Basal length	23·5	21·8	24
Breadth	14·5	13·3	14
Nasals length	9	8	9·5
Intertemporal	5	4·3	5
Palate, length	13·3	12	15
$M^1 - M^3$	4·9	4·6	5

This little animal has possibly as wide a distribution as any Marsupial within the State. It is nowhere abundant, and its numbers in any given locality obviously depend upon season. It extends far into the salt-bush country, and is as much at home in the Centre as it is in the more wooded coast districts. It leads an obscure but useful life, and is usually brought under human notice by being carried into the house by domestic cats. Apparently, though readily caught and killed by cats, it is not a very acceptable article of diet, and several specimens have been obtained which, having been captured and played with, have been abandoned. The females appear to vastly outnumber the males, or else to fall more easy victims to cats and traps, and the measurements of only three males are included in the above list. In South Australia the breeding season is in June and July, and six appears to be about an average litter.

It is a thoroughly useful little animal, and there would be considerably less havoc wrought by insect pests in Australia were the small members of the Genus *Sminthopsis* not preyed upon by domestic cats.

The rather smaller and paler form of the Fat-tailed Pouched Mouse which is found about Killalpaninna has been distinguished by Oldfield Thomas (1902) as *Sminthopsis crassicaudata centralis*. The tail in this variety is relatively long, as in the examples measured by Sir Baldwin Spencer. The dimensions are as follows :—Head and body, 79 ; tail, 63 ; hind foot, 15·5 ; ear, 22.

(2) **Finke River Pouched Mouse.**

SMINTHOPSIS LARAPINTA (Spencer, 1896).

Resembling *S. crassicaudata*, but with a longer tail, and proportionately longer hind feet.

Size small, form light and delicate. Fur very soft and fine, moderately long, composed almost entirely of under-fur with a few long dark hairs. General colour mouse grey, suffused on the dorsal surface with rufous. The sides, under surface of the head and body, and upper surface of the manus and pes are white. The face is marked by a darker stripe passing through the region of the eye. Ears large, laid forward they reach considerably beyond the eye. Palms naked, granular. The posterior external pad is V-shaped with the apex pointing forwards. The ulnar carpal vibrissae are well-developed. Soles granular anteriorly and in the median part ; four pads present, three large ones at the bases of the toes, and a small one at the base of the hallux. Tail much longer than the head and body ;

very stout in its basal part, and strongly incrassated, tapering to a long thin end. Strongly scaled, with, at the proximal end, short hairs which do not hide the scales. Towards the tip the hairs are longer and more numerous.

DIMENSIONS.

	♂	♂	♂
Head and body	88	85	95
Tail	105	95	111
Hind foot	18·2	17·5	18
Ear	14	15	16

The above description is taken from the account of Sir Baldwin Spencer, who obtained the animal at Charlotte Waters. It inhabits the stony tablelands, and is said to live in burrows.

(3) **Hairy-footed Pouched Mouse.**

SMINTHOPSIS HIRTIPES (Thomas, 1898).

Size medium. Colour more or less fawn above, white below, the hairs slate-coloured at the base. Ears very large, laid forward they reach some way beyond the front of the eye. Tail long, slightly incrassated for its basal half, dull whitish throughout.

Manus with a large trefoil-shaped elevation occupying the whole of the palm, the elevation being covered all over with fine silvery hairs, without any of the normal pads. Under surface of digits naked and very finely granulated. Pes with uniformly hairy sole, the middle line of the digits being alone naked. As in the manus there is a single large elevation, clothed with hair, and devoid of separate pads. All the hairs of the foot, above as well as below, are longer than usual, and especially those along the outer surface, where they form a distinct silvery fringe from the ankle to the tip of the fifth digit. Skull stouter and larger than that of *S. crassicaudata*, and with larger bullae.

DIMENSIONS.

Head and body	76
Tail	81
Hind foot	19
Ear	22·5

DIMENSIONS OF SKULL.

Basal length	24
Breadth	15·3
Interorbital	5·1
Palate, length	13·2
$M^1 - M^3$	4·7

The above description is taken from Oldfield Thomas's account of the original male specimen obtained at Station Point, Charlotte Waters. It is obviously a form adapted to a desert habitat, the type of foot even foreshadowing the specialised condition of the feet of the desert-living Genus *Antechinomys*.

(4) Slender-tailed Pouched Mouse.

SMINTHOPSIS MURINA (Waterhouse, 1837).

In general form this little animal is slender and delicate. It is remarkably mouse-like, looking at first sight like a finely built, sharp-nosed monodelphian mouse. The general colour also is very like that of the common house mouse.

Fur fine and soft, mostly consisting of under-fur; the longest hairs of the back measuring 10mm. The face is lighter than the general body colour. A faint darker patch immediately around the eye. The dorsal surface of the body and crown of the head grizzled mouse-coloured, in some specimens rather warmer brown towards the middle line of the back. Chin, throat, under surface of the body and inner side of the limbs greyish; the hairs being smoky grey at the base and white at the tips. Manus and pes almost pure white. The tail is long, and though it is not incrassated, its diameter 10mm. from the base is greater than it is at the base itself; it is finely scaled and uniformly clothed with short pale brown hairs.

The ears are long, laid forwards they reach the middle of the eye, but the length is subject to considerable variation. The back of the ear is naked, save for a tuft of hair springing from the base; uniform brownish flesh-coloured. Within they are pubescent with pale-brown hairs, which are short and very fine. Processus antihelicis is folded. The rhinarium is dark flesh-coloured, naked, finely granular, and cleft in the middle line. The eye is small and black; the eyelashes are fine and coloured light-brown.

All facial vibrissae are well-developed. The mysticial bristles are pale in colour, and the longest measures 21mm. The ulnar carpal set are white and rather short, the longest measuring 9mm.

The manus with naked granular palms, and typical pads as in *S. crassicaudata*. The digital formula is $3 > 4 > 2 > 5 > 1$.

The pes with soles which are hairy at the sides and under the heel. The pads are granular. There are three interdigital pads as in *S. crassicaudata*, but in addition there is a small pad at the base of the first digit (hallucal pad). (*See* Figure 73). The digital formula is $4 > 3 > 5 > 2 > 1$.

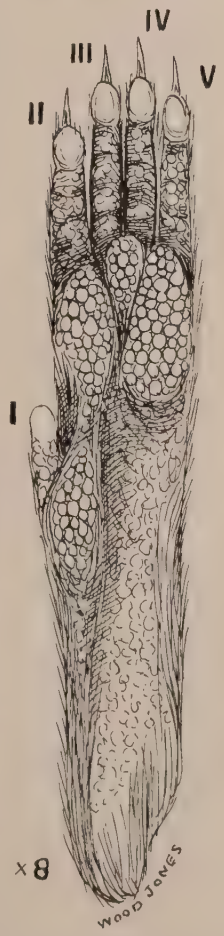


FIGURE 73.—Left pes of *Sminthopsis murina*. Eight times natural size. Showing the pad at the base of digit I., which is absent in *S. crassicaudata* (*see* Figure 71).

The hallux is small and clawless. The pouch is well-developed. The nipples, as a rule, 8 in number. Skull practically identical with that of *S. crassicaudata*.

DIMENSIONS.

	Adelaide.			Brit. Mus.	
	♂	♀	♀	♀	♂
Head and body	95	90	85	84	81
Tail	85	75	72	83	90
Hind foot	15	16	14	16	16
Ear	14	16	15	11·5	13

DIMENSIONS OF SKULL.

	Brit. Mus.
Basal length	25
Breadth	15·3
Nasals, length	9·8
Interorbital	5·4
Palate, length	13·9
$M^1 - M^3$	4·7

Although in books this little animal passes uniformly under the name of "Common" Pouched Mouse, it is by no means a common species. In South Australia it is not nearly so frequently met with as is *S. crassicaudata*. Like the Fat-tailed Pouched Mouse, it is a very variable animal in its general size and proportions; and, as will be seen from the measurements given above, the form of the species which lives about Adelaide is rather remarkable for the shortness of its tail, although it is a somewhat large representative of its species. It is an animal which is very rarely seen except when it has fallen the victim to a cat, and but little is known of its life history. Its range is evidently a wide one; it extends to the Centre, but even there, is nothing like so common as is *S. crassicaudata*.

The form *Sminthopsis murina constricta* (Spencer, 1896), which is unfortunately represented only by a single specimen from Oodnadatta, is a type which is in some ways intermediate between *S. murina* and *S. crassicaudata*. It possesses a tail which is as long as that of *S. murina*, but it is incrassated as is that of *S. crassicaudata*.

DIMENSIONS OF THE TYPE ♀ SPECIMEN.

Head and body	71
Tail	80
Hind foot	15·5
Ear	12·5

Genus 5. ANTECHINOMYS (Krefft,[1] 1866).

Within this Genus are contained the beautiful little Jerboa Pouched Mice of the Centre. They are a specialised saltatory modification of a Sminthopsis-like form, just as the monodelphian Jerboa Mice of the Centre (*Notomys*) are a saltatory modification of a more typical form of mouse. In size they are small; extremely elegant and slender in build, and generally showing a maximum of characters adapted to highly developing jumping habit.

The ears are very large. The tail is very long, and tufted towards its tip. The limbs greatly elongated. The hallux is entirely absent. Soles and palms granular. Pads largely fused into simpler elevations. Soles hairy in the greater part of their length.

Dentition I. $\frac{4-4}{3-3}$. C. $\frac{1-1}{1-1}$. PM. $\frac{3-3}{3-3}$. M. $\frac{4-4}{4-4}$. The bullae at the base of the skull are very large. The animals are terrestrial and saltatory in habit, and insectivorous in diet. Probably only one species is found in South Australia.

FIGURE 74.—*Antechinomys spenceri.* Two-thirds natural size; from a male South Australian specimen.

South Australian Jerboa Pouched Mouse.

ANTECHINOMYS SPENCERI (Thomas, 1906).

In general appearance and size remarkably like the desert-living jumping mice of the Interior. Form slender and graceful, with an almost exaggerated specialisation to a saltatory habit. (*See* Figure 74).

Fur very long and soft, almost wholly composed of under-fur. General colour a grizzled fawn grey. Head grizzled. Hairs dark smoky grey at the base and light at the tips. Immediately around the eye are slightly darker hairs succeeded by paler areas above, below, and in front of the eye. Mid line of the face and crown of the head darker. Occipital region and mid line of dorsal surface darker than the general body colour. The dark crown of the head in contrast to the paler face and snout region is a conspicuous feature. Hairs of the back 14mm. long, very fine and soft, smoky grey at the base, pale at the tips. Chin and throat white, the hairs being white to their roots. Chest and ventral surface white, the hairs being smoky at their roots. Limbs clothed with body hairs only to the upper third of the forearm and middle of the leg (tibia). The rest of the long delicate limbs pubescent with short fine white hairs. Tail much longer than the head and body, clothed with short closely adpressed fawn coloured hairs in rather more than its basal half; in the terminal half the hairs become slightly longer, and in the terminal third constitute a rather prominent pencil of dark-brown hairs, the individual hairs being 10mm. in length. The ears are enormous, folded forwards

they completely cover the eye. (*See* Figure 75). In colour they are pale pinkish fawn. The dorsal surface is pubescent in the upper part (above the line of folding), almost naked below. The inner surface and the margins beset with fine fawn-

FIGURE 75.—*Antechinomys spenceri*. Characters of the head and face, from a male South Australian specimen. Twice natural size.

coloured hairs; the deeper portions of the concha naked. Processus antihelicis thin and leaf-like. Rhinarium brownish flesh-coloured, naked and granular: completely divided by a median cleft in its whole extent. The eye is black, fringed by a row of fine dark eyelashes both above and below. The facial vibrissae are well-developed, the mysticial bristles being 23mm. in length. They are dark at the base, and pale towards the tip. The supraorbital set represented by a single vibrissa only. The ulnar carpal set shows a most remarkable development. The tuft consists of 3 or 4 white hairs, one of which reaches the extraordinary length of 30mm. (*See* Figure 76). The manus has a naked and granular palm with three crowded interdigital pads. The 1st interdigital pad is fused with the thenar pad. The hypothenar pad is large. The digital formula is $3 > 4 > 2 > 5 > 1$. The pes is very highly specialised. The middle line of the sole is darker than the margins; it is hairy in its whole extent, there being a hair vortex just anterior to the posterior third. The only naked portion of the sole consists of one elevation, granular in its fore part, hairy behind. This single elevation represents the fused interdigital pads. The hallux is entirely absent.

FIGURE 76.—*Antechinomys spenceri*. Fore limb to show the great development of the ulnar carpal vibrissae. Twice natural size.

The digital formula is $4 > 3 > 5 > 2$. (*See* Figure 77). The pouch is entirely absent. The nipples are 6 in number, arranged in a circle. The skull is light and delicate. It is broad in general outline. The nasals are not expanded at their posterior ends. The bullae are extremely large; and mastoid inflation is also well marked.

DIMENSIONS.

	S.A.	S.A.	Spencer. Horn Expedition.				
	♂	♀	♀	♂	♀	♂	♂
Head and body	110	110	100	95	95	87	82
Tail	144	120	136	138	136	129	116
Hind foot	33	30	32	33	31	28·5	29
Ear	22	21	21	19	20	23	22

DIMENSIONS OF SKULL.

Basal length	26·7
Breadth	15·7
Interorbital	5·6
Palate, length	15·3

Although first described in 1866 *Antechinomys* remains an extremely rare animal, and specimens are very difficult to obtain. It is a creature of the more arid regions, where sand ridges and tussocks of stunted vegetation constitute the typical environment. It furnishes a good example of the scarcity in numbers of carnivorous as compared with herbivorous animals; for though utterly different in every fundamental feature from the monodelphian Jerboa Mice (*Notomys*) of the Centre it is in general build and habit remarkably like these creatures; and yet *Antechinomys* is an animal of the greatest rarity, while the vegetarian mice exist in vast numbers in the same environment.

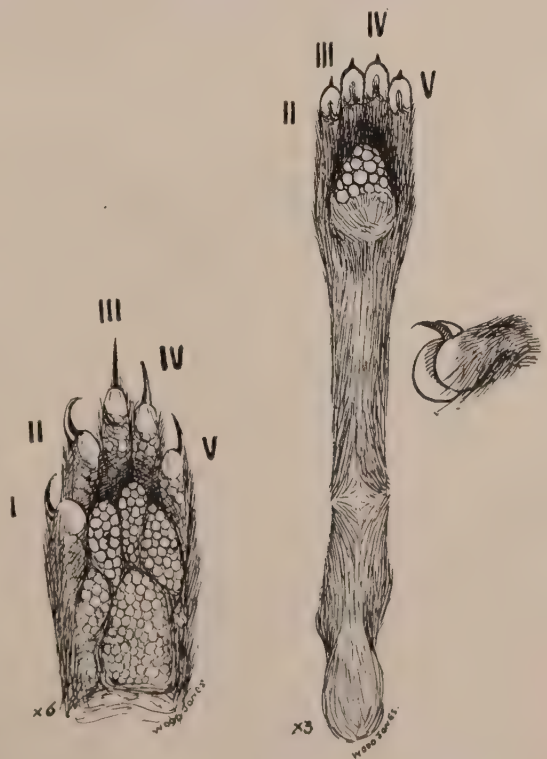


FIGURE 77.—*Antechinomys spenceri*. Left manus and pes. Manus six times, pes three times natural size.

It is a remarkably specialised saltatory animal which spends the hottest hours of the day in burrows in the sandhills. Though extremely rare, its range is probably a wide one. The specimens taken by the Horn Expedition were from the Missionary Plains, beyond the northern limits of this State, but subsequent examples have been procured from Charlotte Waters, and it is practically certain that it exists far into South Australia in the enormous tract of country where sand ridges, stony table lands and stunted saltbush provide it with its elected habitat. The South Australian form was named *Antechinomys spenceri* by Oldfield Thomas, after Sir Baldwin Spencer, from specimens collected at Charlotte Waters. The old-established species known as *A. laniger*, which is slightly smaller, and has shorter ears and far smaller bullae, does not appear to have been found in this State.

Family III.—THYLACINIDAE.

This Family contains but a single Genus—*Thylacinus* (Temminck, 1825)—which is represented only by a single living species. Known variously as "wolf," "tiger," and "hyaena" this animal (*Thylacinus cynocephalus*) is in general build rather dog-like. (*See* Figure 78). It has ceased to be an inhabitant of continental Australia, but at one time it flourished in this State. Its remains are present among the bone deposits of the Bukalowie caves near Carrieton. At the present day it is confined to Tasmania, and it lingers now only in a few of the more inaccessible and mountainous parts of the country.

Figure 78.—*Thylacinus cynocephalus.* General appearance of the animal about one-twentieth natural size. The outline depicts the hindquarters of a dog of comparable build, and is inserted to show the difference in the manner in which the hind end tapers to the tail in the two animals.

Family IV.—MYRMECOBIIDAE.

The Family contains only a single Genus, in which is included but one described species.

The molar teeth exhibit characters which are probably degenerate rather than primitive; and they exceed $\frac{4-4}{4-4}$ in number.

The tongue is elongated, cylindrical, and extensible. The palate is complete, and unusually prolonged. The pouch is entirely absent.

Genus.—MYRMECOBIUS (Waterhouse, 1836).

The Genus is a remarkable one, distinguished from all other didelphian Genera by several very striking features. The snout is long and tapering; the rhinarium naked. The ears are simple. The tail is long and clothed with harsh brush hairs.

The manus has 5 digits, the pes only 4; all digits armed with strong claws. The pads of sole and palm are reduced and punctate. The skull is broad and rounded; the nasals expanded in their posterior portion. The bullae are large. The angle of the lower jaw is but little inflected. Dentition—I. $\frac{4-4}{3-3}$, C. $\frac{1-1}{1-1}$, P.M. $\frac{3-3}{3-3}$, M. $\frac{5-5}{6-6}$. Terrestrial in habit, and insectivorous in diet.

FIGURE 79.—*Myrmecobius fasciatus.* A female South Australian specimen. Half natural size.

Banded Ant-eater. Marsupial Ant-eater. White-banded Bandicoot.

MYRMECOBIUS FASCIATUS (Waterhouse, 1836).

These names are all merely book designations, for the animal appears never to have been sufficiently common or conspicuous to have earned a popular or familiar name. To the aboriginals, however, it is known as the Numbat, and this name will be adopted here.

The Numbat is an animal which possesses the distinction of being so peculiar a creature that it cannot possibly be mistaken for any other species. It must be emphasised at the outset, however, that the South Australian form differs very markedly from the Western Australian type of the species. It is the Western form which was described and named by Waterhouse, and the description of the species in all works dealing with the Australian fauna applies to that type. Here the description is of a typical South Australian example, which I propose to describe in a scientific journal under the name *Myrmecobius rufus*.

The animal is about the size of a rat, and in form it is generally likened to a squirrel, but the simile is extremely unapt. (*See* Figure 79). Its figure differs from that of most small mammals in the remarkable breadth and flatness of the hinder part of its body; the region of the loin, instead of being arched in typical mammalian fashion, is flattened much as it is in the lizards. This is the most characteristic feature of the general form of the animal, and it quite destroys any likeness that the Numbat might otherwise have to a squirrel. The head is also remarkably flat. The coat is harsh and coarse, the hairs of the dorsal surface

being especially hispid, each hair having the character of a fine, sharply pointed bristle. The general colour is bright rust red, becoming increasingly dark towards the hind end of the body. The region of the loins is coloured a fine bright brown, but nowhere does it become black. Upon the crown of the head and the fore part of the back is a slight admixture of creamy white hairs, some of which are white to their roots, and some only white at the tips. Towards the hinder (darker) extremity of the body the white tipped hairs become more regularly disposed, and constitute six or seven creamy white bars adorning the dorsal surface of the

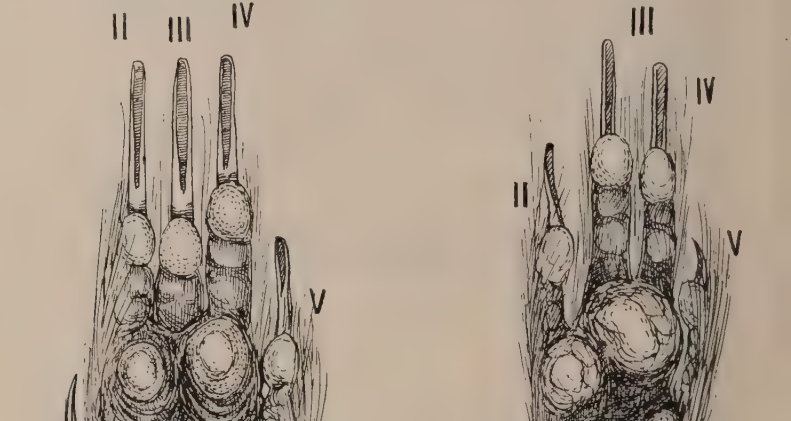


FIGURE 80.—*Myrmecobius fasciatus*. Left manus and pes of a Western Australian specimen. Manus three times, pes twice natural size.

body and loins. Of these pale bands the three posterior ones are complete and conspicuous, the three or four anterior ones are narrow and often interrupted in the mid dorsal line. It is not uncommon for the median ends of the bands to overlap, so that the pattern is not the same upon the two sides of the body. In front of the defined bands there are often traces of others, and in some specimens there are suggestions of as many as nine bars, the anterior ones being only just discernible. Upon the chin, throat, ventral surface of the body and inner aspect

of the limbs the hair is shorter and uniformly sandy-coloured. The muzzle is darker than the general colour of the head, and is clothed with extremely short hairs. A dark cheek stripe runs from the muzzle to the eye, thence to the ear; above and below this stripe there are paler areas, the lower pale stripe being better marked than the upper one. The tail is long and uniformly clothed with stiff, harsh hairs, which stand out boldly and constitute a brush. The individual hairs are nearly 30mm. in length. In colour the tail is a uniform grizzle of rust red and dark brown, the hairs being dark at the base and paler at the tips. The ears are rather small, considerably thicker than those of the Didelphia already described, and apparently incapable of being folded. They are clothed upon both surfaces with very short hairs, bright rust-coloured without, paler within. The processus antihelicis is small and thick. The rhinarium is naked, granular, dark-brown in colour and cleft in the middle line. The nostrils are cleft laterally. The eye is dark-brown, the pupil circular, the eyelashes are sparse and black. Vibrissae are not well-developed, the mysticial set being singularly reduced. The genal tuft is most marked and consists of three or four black bristles some 15mm. long. Only two supraorbitals are present. The ulnar carpal set is unrepresented. The manus has 5 digits. The palms are naked, dark in colour, and punctate in texture. The pads consist of coarse elevations, of which there are two large interdigitals in the fore part of the palm, two smaller ones at the bases of the 1st and 5th digits, and a large one far back upon the ulnar side. The digital formula is $4 > 2 > 3 > 5 > 1$. Apical pads are well-marked; the claws are long and curved; the digits clothed with coarse hair to their tips. The pes has 4 digits. The sole is naked, save for the overlap of coarse hairs from the sides. The pads are reduced, there being two large interdigitals in the fore part of the sole, a small one at the base of the 5th

FIGURE 81.—The four embryos of *Myrmecobius fasciatus* adhering to the mother's nipples. From a Western Australian specimen. Half natural size.

FIGURE 82.—The pouch area and nipples of *Myrmecobius fasciatus*. The embryos have been removed from the nipples. Same specimen as illustrated in Figure 81. Half natural size.

digit, and another small one marking the site of the absent 1st digit. The digital formula is $3 > 4 > 2 > 5$. The hallux is not developed. (*See* Figure 80). The pouch is entirely absent, its site being marked by specialised crimped hairs, finer

in texture than the general body hairs. The nipples are four in number, arranged at the four corners of a square. (*See* Figure 82). The essential characters of the skull are shown in Figures 37, 83, and 84.

DIMENSIONS.	South Australia. ♂
Head and body	175
Tail	135
Hind foot	43
Ear	20

DIMENSIONS OF SKULL.

	Western Australia. ♂	♀
Basal length	50	45
Breadth	29	25
Palate, length	35	32
Interorbital	15	14
Nasals, length	20	17

The Numbat was probably never a very abundant animal, but its distribution was comparatively wide. Only twenty years ago it was met with along the scrub lands of the Murray, and earlier than that it existed quite near to Adelaide. Enquiries as to its present existence have produced negative replies from all those parts of the State in which there are schools, and the circulation of its picture and description to more remote districts have proved equally unavailing. The aboriginals who are attracted to civilisation, as it is represented by the East-West railway, know the animal, but so far have failed to supply any evidence as to its actual existence at the present time. If the Numbat still exists in South Australia it is probably towards the Western Australian border, and here it is probably the Western Australian form. The characteristic South Australian type has probably gone for ever. Extremely little of the South Australian material was preserved when it was obtainable ; and now we know it only from the most meagre remains. The Western Australian animal is now excessively rare, and it is probable that before many years are passed it will follow its South Australian neighbour into extinction. The extermination of the Numbat is a tragedy in which man has probably played very little conscious part ; it is no tale of ruthless slaughter for gain, such as is being rehearsed to-day in regard to the Australian fur-bearing animals, nor is it a case of determined persecution as is the case with the Tasmanian Devil. *Myrmecobius* is an animal which is probably phylogenetically senile, which has become highly specialised in function and degenerate in some details of structure. Added to this is the fact that its home is invariably made in the hollow of a fallen tree or a rotting log. Accidental bush fires and the intentional burning off of country seem to have found the Numbat an easy victim, and they have exterminated it as they are exterminating other small terrestrial Marsupials. There is no escape from a bush fire for the Numbat. It does not excavate deep burrows, it does not climb, it is not fleet of foot—as its log home burns, it perishes.

Of its habits we know extremely little, and very few white men appear to have made observations upon the living animal. The original account by Gilbert, in Gould's great work, contains obvious inaccuracies ; and I know of no records of

the animal having been kept in captivity. It is surely a tragedy that this most interesting animal has probably passed out of existence in our State, and is rapidly repeating the process in a neighbouring one without any proper study having been made of it, and without any representative collection having been made of its remains. It will not be long before *Myrmecobius* will be as extinct as those Mesozoic Marsupials of the English Jurassic beds of which it has been said to be " actually an unmodified survivor." It is said to be absolutely inoffensive, to make no attempt to bite, and to utter a low grunt when handled. The breeding season in Western Australia is in June and July, and four young constitute the normal litter. There being no pouch, the young animals cling tightly to the mother's elongated nipples, and are dragged about back downwards in all her activities. (*See* Figure 81). The young are distinguished among the Marsupials by being remarkably unlike the parent animals. The Numbat is insectivorous and crepuscular.

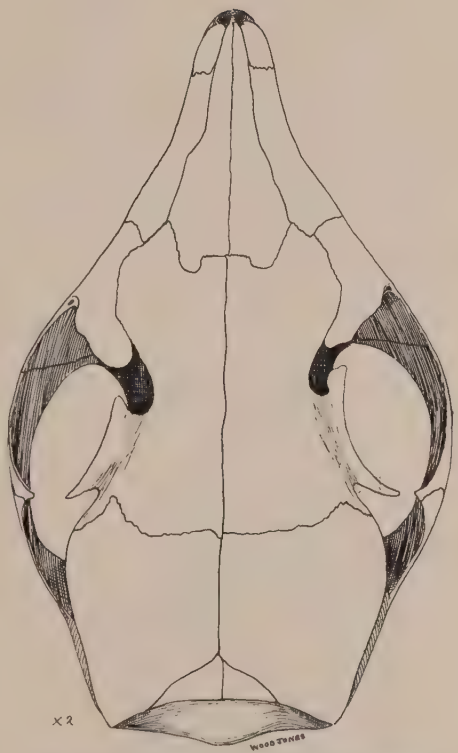


FIGURE 83.—Skull of *Myrmecobius fasciatus* seen from above. South Australian specimen. Twice natural size.

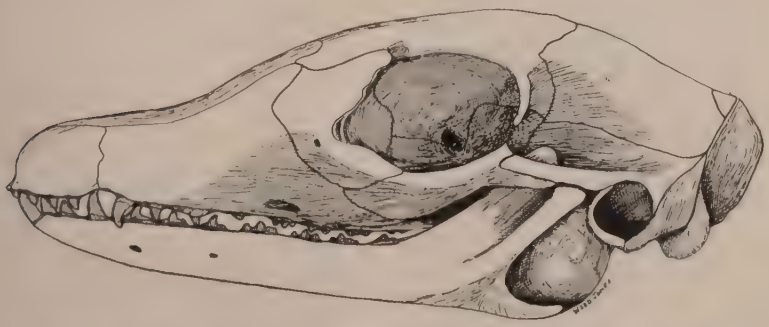


FIGURE 84.—Skull of *Myrmecobius fasciatus*. Side view of a South Australian specimen. Twice natural size.

Family V.—NOTORYCTIDAE.

General appearance mole-like, the Family containing only a single remarkable Genus. Limbs short, stout, and strong, with 5 digits on both manus and pes. The eye is absent. There are no external ears. The cervical vertebrae are fused together.

Genus.—NOTORYCTES (Stirling, 1891).

The Genus of "Marsupial Moles" is one of the most remarkably specialised products of the Didactylous section of the Didelphia. The dorsal aspect of the muzzle is covered with a hard shield. External ears are absent, there being only a small opening which is buried beneath the fur. Tail reduced to a rudiment, clothed by hard skin. Manus highly specialised for digging. Fur fine and silky. Pouch opening backwards

Figure 85.—*Notoryctes typhlops.* Ventral view of a female specimen from Ooldea. Natural size.

Marsupial Mole, or Pouched Mole.

Notoryctes typhlops (Stirling, 1891).

This remarkable little animal which, discovered in 1888, was for some time one of the mysteries of the Australian fauna can now probably claim to be one of the best known Marsupials.

In general form it is strikingly like the African Golden Moles (*Chrysochloridae*). The fur is fine and silky, in colour varying from almost white to a rich red golden hue. When living, the coat has a remarkable sheen, which has been described as an iridescence, but which is very similar to the appearance of very fine plush. The long hairs of the back measure 13mm.; but the coat consists almost wholly of under-fur. There is a curious patch on the hinder part of the back, where the hair has the appearance of being matted. Fur clothes the short limbs as far as the wrist and ankle. The tail is reduced to a mere rudiment, 20mm. in length, and covered by a horny skin which is marked by a series of rings encircling its girth; the tip consists of a little horny knob. (*See* Figure 85). The whole rhinarium consists of a horny shield, which is divided into upper and lower portions by a

transverse groove. The nostrils are small and slit-like. Although marked by a conspicuous pigment spot in the embryo, the eye is completely degenerated in the adult. The external opening of the ear is marked as a little round hole buried beneath the fine silky hair of the side of the head. No sensory vibrissae are discernible anywhere upon the animal. The mouth is rather small, and is situated ventrally (*see* Figure 86). The manus and pes are remarkably modified. The sole and palm are thick and horny, without definite pads. The manus is curiously folded so that the small 1st and 2nd digits are opposed to the relatively enormous claws of the 3rd and 4th. The 5th digit is small and ends in a little horny boss rather than a claw.

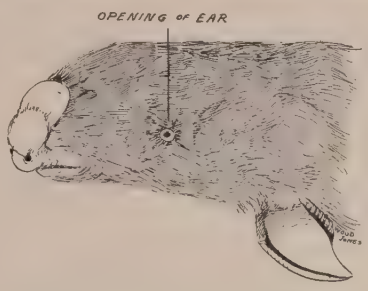


FIGURE 86.—Head of *Notoryctes typhlops*. The hair has been parted in order to show the external opening of the ear, which is normally buried beneath the fur. Natural size.

In the pes the 2nd, 3rd, and 4th digits bear claws; the 1st has a short horny point and the 5th is a rudiment. (*See* Figure 87). The pouch is well-developed, extending some distance forwards in front of its mouth; the nipples are two in number. The skull is light and delicate and of very peculiar shape. (*See* Figure 88). The full detention is—I. $\frac{4-4}{3-3}$, C. $\frac{1-1}{1-1}$, P.M. $\frac{2-2}{3-3}$, M. $\frac{4-4}{4-4}$; but irregularities in the number of teeth are very common.

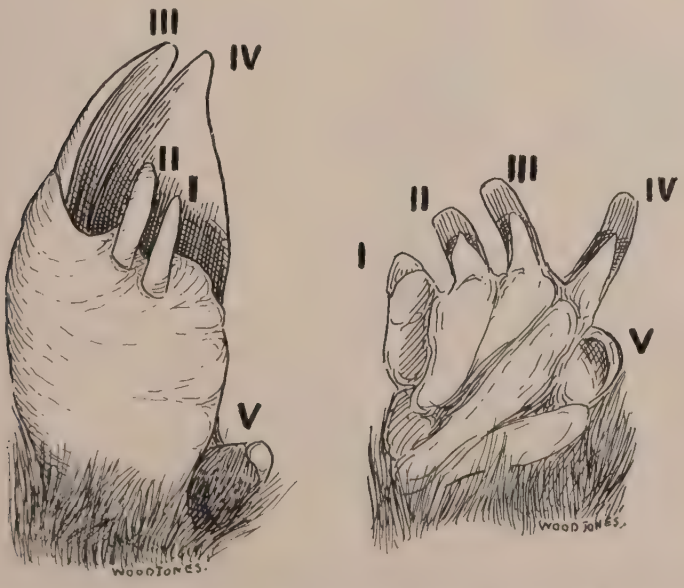


FIGURE 87.—Left manus and pes of *Notoryctes typhlops*. Three times natural size.

Dimensions of an average male South Australian specimen :—Head and body, 145 ; tail, 20 ; hind foot, 10.

Notoryctes is an inhabitant of the sandy and more arid parts of the country, and, owing to the nature of the soil in which it lives, is apparently not so completely a subterranean animal as are the true moles. The burrows which it makes in search of food are not permanent like the tunnels which are left by the European mole, and a portion of its time seems to be spent in furrowing the surface sand. It is, however, probable that it constructs deep permanent burrows in which the female lives and produces her young.

The Marsuipal mole not only resembles the monodelphian moles in its burrowing habits and its anatomical adaptations ; it also resembles them in certain physiological traits. It may be said to be like to the moles in its feverish restlessness. It evinces the most remarkable nervous activity. It makes endless tours around the confines of its cage, each peregrination being undertaken with characteristic energy and haste. It will search with feverish activity in each corner of its box, and regularly in each of the four corners turn a complete somersault in its enterprises. Suddenly it will discover something edible ; the meal is accomplished with a maximum of speed ; the performance is repeated and, in the case of a captive specimen I have observed, a handful of earthworms will be noisily accounted for in a remarkably short time. The meal having been ingested at top speed, the animal will again start upon its rapid tour ; but it has proceeded maybe no more than a foot or two when, as suddenly as it awoke to activity, it is fast asleep. Even its sleep seems hurried. It breathes rapidly. It awakes with a start and is off again. It does not evince fear, nor resent handling, in the least, and when held in the hand will take a considerable quantity of milk at a great pace, and then on a sudden fall asleep again. In all its activities it carries its extraordinary stump of a tail erect in a manner singularly reminiscent of its lizard companion of the Centre—*Nephrurus asper*. Its gait is a rapid shuffling, the movements of its body strangely fluid and sinuous, so that when held lightly

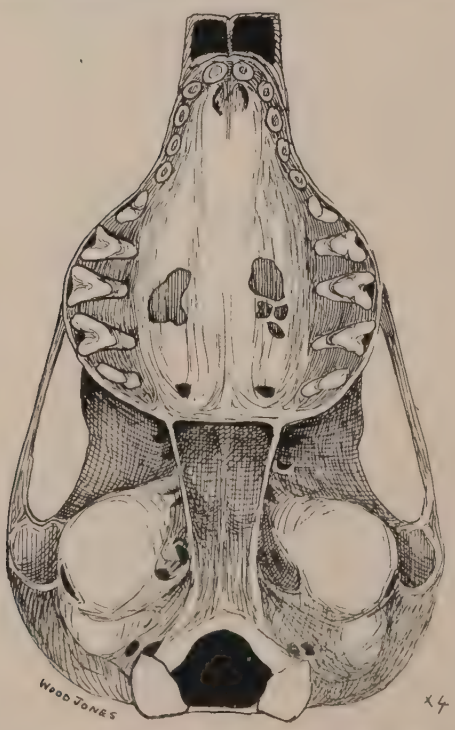


FIGURE 88.—Basal view of the skull and upper teeth of *Notoryctes typhlops*. Four times natural size.

in the hand it seems almost to flow between the fingers. It is said that when moving on the surface of the ground the tail is " adpressed and used as a fulcrum " ; but this is an observation I am unable to corroborate. Nor am I in agreement with those who suppose that " fear has a good deal to do with their dying so quickly in captivity." It is true that their life seems to be carried on at such a high pitch that they appear as " very nervous little animals " ; but I suspect that their active metabolism comes to an end rather through lack of food than from fright. Apparently they need an extraordinary amount of food when active ; but possibly when inactive they can sustain prolonged fasts. They seem to be animals which live either at fever pitch or to remain almost wholly quiescent as season and circumstance demand. Of its breeding habits nothing is known, and the only embryo that I have succeeded in obtaining was the solitary occupant of the pouch.

Notoryctes has a far wider distribution than was imagined a few years ago. The original specimens were procured beyond the northern boundaries of South Australia : and in 1896 Spencer gave its range as extending " as far south as Charlotte Waters," just beyond the northern limits of this State. Since then it has been found in Western Australia, where it is represented by a distinct form named *Notoryctes caurinus* (Thomas), and in various parts of South Australia, where the typical sand ridge country with mulga and stunted saltbush provides a suitable habitat.

When the Transcontinental Railway from Perth to Port Augusta was under construction a most regrettable waste of scientific information was permitted. It is greatly to be hoped that a similar sacrifice of scientific interests will not be repeated when the route of the North-South Railway is constructed. *Notoryctes* was met with at several points during the laying of the railway line, but most of the material was wasted. It has remained for Mr. A. G. Bolam, of Ooldea, to preserve such specimens as came into his hands. To this gentleman South Australia is indebted for preservation of specimens, acquirement of knowledge, and the keeping of records of the native fauna and of the native tribes made known, and about to be exterminated, by the passage of the railway.

Handbooks of the Flora and Fauna of South Australia, issued by the British Science Guild (South Australian Branch) and published by favor of the Honorable the Premier.

THE MAMMALS

OF

SOUTH AUSTRALIA.

By FREDERIC WOOD JONES, D.Sc.

Part II.

CONTAINING

The Bandicoots and the Herbivorous Marsupials.

(The syndactylous Didelphia.)

WITH ILLUSTRATIONS.

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1924.

NOTE.

In Part I., at pages 94 and 102, the name of the Genus which contains Krefft's Pouched-mouse was given as *Chaetocercus*. This is the name originally used by Krefft in 1866, and it was employed in preference to the most modern name *Amperta* –given to the Genus by Angel Cabrera in 1919.

As a matter of fact when Krefft employed the term *Chaetocercus* that name was already preoccupied, it having been previously given to an avian Genus (containing certain Swifts) and therefore it was not available for a Genus of Mammals. The name *Amperta*, however, does not stand, for it is antedated by *Dasycercus* employed by Peters in 1875. *Dasycercus* should, therefore, be the name of the Genus (Genus 2, pp. 94 and 102, Part I.), and for the two species *Dasycercus cristicauda* (p. 102) and *Dasycercus hillieri* (p. 109).

For the loan of the blocks of figures 106 and 108-123, previously published in the Records of the South Australian Museum, I am indebted to the Board of Governors of that institution. For the loan of the blocks of figures 92, 95-98, and 138-141, previously published in the Transactions of the Royal Society of South Australia, I am indebted to the Council of that Society.

Sub-Order II.—SYNDACTYLA.

Unlike the didactylous Sub-order of the marsupials, the Syndactyla do not form an entirely simple group. The composite nature of the section, which contains the marsupials having conjoined second and third toes, has already been mentioned (Part I., page 83). We have pictured the origin of the group as consisting essentially in the acquirement of a curious foot specialisation, and we have imagined that originally the animals that attained this specialisation possessed the full set of front teeth typically associated with an insectivorous, carnivorous, or mixed diet. We have further concluded that some of the animals which developed the specialised feet, also developed specialised front teeth—the dental specialisation consisting in a reduction in the number of the front teeth, a modification typically associated with a vegetarian diet. The whole Sub-order may, therefore, be divided into two main groups: the one with many front teeth, which may be termed Syndactyla Polyprotodontia; and the other with few front teeth, which may be called Syndactyla Diprotodontia.

Before proceeding to discuss the actual animals which are embraced within these two groups it will be well to examine the peculiarity that bands them all together as Syndactyla. The condition of syndactyly is a very peculiar one, and needs

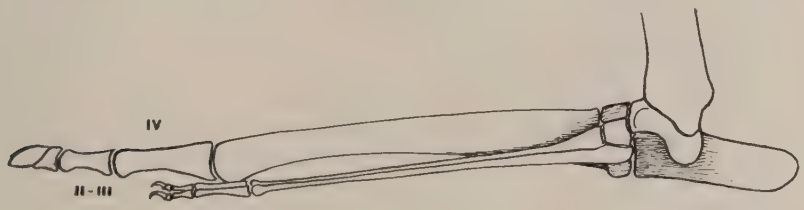

Figure 89.—The skeleton of the right foot of a Kangaroo seen from its inner side to show the slender bones of the syndactylous second and third digits.

discussion both from the point of view of the anatomical adaptations involved and the functional end to which the anatomical arrangements are applied. Anatomically two small toes—the second and third—are bound together in the whole of their length, with the exception of their top joints and their claws. There is thus produced an apparently single toe, terminating in twin tips and twin claws. Beneath the skin are the slender bones which form the shafts of the toes (*see* Figure 89), and the muscles which, properly belonging to two separate toes, have become grouped so as to act on the single compound toe. These muscles can bend the whole compound digit and straighten it again; and they can also drew it away from the side of the foot and pull it back, so that the syndactylous digit may be placed almost at right angles to the foot, or brought so that it lies in line with the rest of the toes. (*See* Figure 90.)

As to its function, Sir Richard Owen, in 1839, stated clearly that essentially syndactyly consisted in the "conversion of the two inner toes into unguiculate appendages, useful only in cleansing the fur." Despite this plain statement that the syndactylous digits could be employed as hair combs, this function seems

largely to have been lost sight of by later writers. Although Owen assigned a functional role to them, it is quite obvious that he regarded this as only a very secondary thing—a sort of makeshift use for a structure which had fallen behind in perfection. Syndactyly he certainly regarded as a condition of degeneration, for he says "the commencement of a degeneration of the foot which is peculiar to and highly characteristic of marsupial animals may be discerned in the Petaurists, in the slender condition of the second and third toes, as compared with the fourth and fifth."

The idea that this peculiar arrangement of the small second and third toes is the result of degeneration seems to be a very general one among those who have studied the marsupials. It is true that the toes are very small; it is true that they have ceased to play any part in walking or running or climbing, and so may be said not to share in the more obvious functions that we associate with toes. But it must also be admitted, if we reflect for a moment, that it is a very curious thing that toes should join together in a remarkably ordered fashion and then degenerate in company. Plenty of toes have degenerated, and become lost, in the story of the various marsupial groups; but this is the only occasion in which they seem, so to speak, to have become united in death.

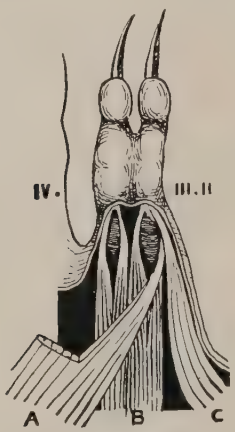

FIGURE 90. The muscles which act upon the syndactylous toilet digits. A, the muscle which pulls the hair comb to the next digit when unemployed. B, the muscles which bend the claws down. C, the muscle which pulls the comb from the side of the foot for scratching.

Maybe we shall do better to regard these very wonderful toes as forming a highly organised anatomical mechanism specialised as a hair comb, rather than as degenerate toes used in their decaying stages as a hair comb, because there is no other use for them in their decrepitude.

At first sight it might appear that it was a matter of little moment if we regard the syndactylous digits as degenerated or as specialised; but the question is in reality one of some interest. We have already found some reasons for considering that the division of all Didelphia into two groups, distinguished by their dentition as Polyprotodontia and Diprotodontia, was not a satisfactory arrangement. If we are to have two basal groups of polyprotodonts and diprotodonts, then we must assume that syndactyly has been developed independently in each group. Were the condition of syndactyly to be one of simple degeneration, then it is perhaps not difficult to picture it as affecting the pedal digits of certain members of both series independently. But if the condition be the result of a very specialised development, begot in response to the demand of a very definite function, then, though its independent and identical development in both stocks cannot be regarded as in any way impossible, it is sufficiently unlikely to warrant our electing the simple explanation of its only having been developed once, and that in the stock in which it appeared some members retained the primitive polyprotodont dentition and some attained to the more specialised diprotodont stage.

The syndactylous digits attain a very different degree of development in the various members of the group. In some animals the twin toes are long, in some they are short. We might say that the toes are present in a varying degree of degeneration, or we might assume that they were present in a varying degree of specialisation. It needs only a very superficial review of the Syndactyla to realise that the state of development of the syndactylous toes is related to the nature and texture of the hairy coat of the animal, rather than to its systematic position in the series. The Koala (*Phascolarctus cinereus*) has much better developed syndactylous digits than have the Bandicoots. This we suppose to be a consequence of the presence of a long dense woolly coat in the Koala and a short hispid hairy covering in the Bandicoots; and not a result of more degeneration having taken place in the primitive Bandicoots and less degeneration in the far less primitive Koala.

No one who has watched the functional employment of the little twin toes as a hair comb can doubt that they constitute a highly developed and thoroughly efficient toilet implement. The muscles pull the compound toe so that it projects from the side of the foot; it is then slightly bent, and with its little parallel claws the hair is systematically raked wherever the toes can reach. After the combing has been done the comb is cleansed, and for this purpose the lips and teeth are usually employed.

If we seek to find out why this wonderful comb should have been developed we are, of course, confronted by a problem to which it is almost impossible to find the real solution. We can at least say that the development of preening organs and hair combs is a very wide-spread and familiar phenomenon in the animal kingdom. The syndactylous hair comb is, therefore, no isolated or outlandish development. The particular need which called it into existence in only certain of the marsupials can merely be guessed at. We have already (Part I., p. 59) noted that the Biting-lice, known as *Mallophaga*, are very abundant parasites in the hairy coats of many marsupials. *Mallophaga* are certainly much more prevalent in the fur of the Syndactyla than they are in that of the Didactyla. When one of the carnivorous marsupials, which we have already studied, is irritated by something which produces a tickle, it scratches itself with the claws of its hind foot and, if this does not effectively allay the itching or dislodge its cause, it will nibble with its sharp little front teeth, which act as a very fine hair comb. It may be that those marsupials that departed from an insectivorous and carnivorous diet, and started on an increasing specialisation of vegetarianism, missed the sharp little front teeth in the toilet of the coat, and found a substitute in the specialised hair comb of the pedal digits. Bandicoots will nibble their hair; but their ability to nibble it and the effectiveness of their front teeth as hair combs are considerably reduced; for, despite the fact that they are polyprotodonts, their front teeth have fallen from the standard of the sharp pointed incisors of the Didactyla. The pedal hair comb is initiated in them, presumably as an additional toilet implement; its need and its perfection are increased when the many little front teeth have become replaced by the few larger front teeth of the specialised diprotodonts.

For the purposes of classification the Sub-order is, therefore, best divided into two sections, the one containing a far more primitive and generalised set of animals than the other.

SUB-ORDER SYNDACTYLA.

(A.) Syndactylous didelphia with a full set of front teeth.

Section. SYNDACTYLA POLYPROTODONTIA.

(A[1].) Syndactylous didelphia with a reduced set of front teeth.

Section. SYNDACTYLA DIPROTODONTIA.

SECTION I.—SYNDACTYLA POLYPROTODONTIA.

This section contains the more primitive omnivorous members of the Sub-order, known collectively as Bandicoots, which may all be grouped within a single family

FAMILY PERAMELIDAE.

The characters of the members of the Family are as follows :—Fossorial in varying degree, all being adept excavators for the purpose of obtaining food. Practically omnivorous in diet. In general appearance there is a rough resemblance, in the case of the larger species to rabbits, and in the case of the smaller species to rats. The muzzle is elongated and tapering, terminating in a naked rhinarium slightly grooved in the middle line, with nostrils cleft upon their lateral aspects. Ears long or medium. Hind limbs longer than fore limbs. The middle three (or only two) digits of the manus well developed and clawed ; the lateral digits rudimentary or absent. On the pes, the first digit is rudimentary or absent ; the second and third are slender, clawed and syndactylous ; the fourth is the largest toe and continues the mid-line of the axis of the foot. The fifth digit is present, smaller than the fourth, but, like that digit, it carries a well developed claw. The tail is long or medium, hairy or crested. The pouch is present, the mouth opening downwards and somewhat backwards ; the nipples are six or eight in number. The patella is developed. Clavicles are absent.

Dentition I. $\frac{5-5}{3-3}$ or $\frac{4-4}{3-3}$. C. $\frac{1-1}{1-1}$. P.M. $\frac{3-3}{3-3}$. M. $\frac{4-4}{4-4}$. Incisor teeth with flattened, not pointed crowns.

In general it may be said that the Peramelidae are rapidly disappearing over the whole of continental Australia. Although formerly they were very common and familiar animals, they have now disappeared from many of their old haunts, and even though they are still locally abundant in certain spots, their numbers as a whole have vastly diminished in a comparatively few years.

Some thirty species are contained within the Family, and these may be conveniently separated into seven distinct Genera. The Genera are distinguished as follows :—

(A.) Manus with five digits.

(B.) Pes with five digits.

(C.) Skull with large pear-shaped bullae.

Genus 1. *Isoodon.*

(C¹.) Skull with small rounded bullae.
(D.) Incisors $\frac{5-5}{3-3}$.
(E.) Cranium short. Bullae complete.
Genus 2. *Perameles.*
(E¹.) Cranium elongated. Bullae incomplete.
Genus 3. *Peroryctes.*
(D¹.) Incisors $\frac{4-4}{3-3}$.
(F.) Last premolar considerably larger than those in front. Genus 4. *Echimypera.*
(F¹.) Last premolar considerably smaller than those in front. Genus 5. *Suillomeles.*
(B¹.) Pes with four digits. Genus 6. *Thalacomys.*
(A¹.) Manus with three digits. Genus 7. *Choeropus.*

GENUS 1.—ISOODON (Geoffroy, 1817).

The members of the Genus *Isoodon* are sturdily built, compact animals, with short, erect, harsh coats and a general grizzled colouration. The muzzle is elongated into a snout. The rhinarium is naked and marked by a median groove. The ears are short, barely reaching to the eye when laid forwards, and somewhat thick in texture. The main processus antihelicis is large and is twisted upon itself at its margin. The secondary process is small. A well marked sulcus auris posterior or bursa is present, and in addition there is a well developed preauricular pit. (*See* Figure 91.) Manus and pes with naked, coarsely granular, palms and soles. The first and fifth digits of the manus small, the third, second and fourth are well developed and clawed. The first pedal digit is small, the second and third are syndactylous, the fourth and fifth well developed and clawed. There are distinct pads on palm and sole.

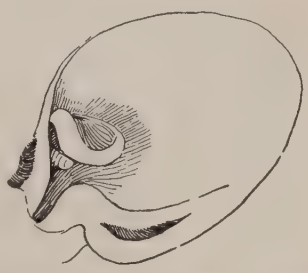

FIGURE 91.—The form of auricle characteristic of the members of the genus *Isoodon.*

FIGURE 92.—Posterior extremity of the base of the skull of *Isoodon obesulus* to show the form of the bullae. Twice natural size.

Dentition I. $\frac{5}{3}\frac{5}{3}$. C. $\frac{1-1}{1-1}$. P.M. $\frac{3-3}{3-3}$. M. $\frac{4-4}{4-4}$. Bullae large and pear-shaped. (*See* Figure 92.)

Two species inhabit South Australia, the one being a continental and the other an insular form.

KEY TO THE SOUTH AUSTRALIAN SPECIES.

(1) External characters.

(A) Size large: head and body length about 300 mm. Colour a uniform dark grizzle; paler below. *I. obesulus.*

(A¹) Size small: head and body length about 240 mm. Colour lighter; ventral surface pure white. *I. nauticus.*

(2) Cranial characters.

(A) Basal length about 70 mm. Bullae elongated. Skull ridged. Nasals long. *I. obesulus.*

(A¹) Basal length about 50 mm. Bullae truncated. Skull devoid of ridges. Nasals short. *I. nauticus.*

(1) **Short-nosed Bandicoot.**

ISOODON OBESULUS (Shaw, 1797).

General form robust and compact. (*See* Figure 93.) The coat is composed of short, harsh spines, so fine as to compose a rather crisp, hairy coat. The individual spines are grooved upon one surface and rounded on the other, and they taper to a fine pointed tip. The coat, though harsh and hispid, is glossy; and the living animal appears far more sleek than an examination of dried skins or stuffed specimens would lead one to suppose. Beneath the bristle hairs is a soft, but rather scanty, under-fur. The under-fur is dark-grey in colour; the individual hairs being lighter

FIGURE 93.—An adult male *Isoodon obesulus*, the animal from Blackwood, Mount Lofty. Slightly less than half natural size.

at their tips. Most of the bristle hairs are banded, being light at their roots, black or dark-brown in their middle portions, and yellow or straw-coloured at their tips. Some of the bristle hairs, however, are brown in the whole of their extent. The banding of the bristle hairs produces a general grizzle of the coat; and the animal, which appears as a warm brown at a short distance, is seen on closer examination to be flecked all over with a very fine grizzle of black and yellow. The inner sides of the limbs and the ventral surface are, as a rule, yellowish-grey; the bristle hairs being greyish and the under-fur almost white. The dorsum of the manus and pes

lighter than the general body colour. The tail is comparatively short, and it is very commonly mutilated, probably as the result of fights. It is uniformly clothed with short hairs, greyish-brown above and dirty-white below. The ears are small and rounded and are clothed, both within and without, with fine yellowish-grey hairs. The processus antihelicis is long and shows a twisted free margin. The bursa, and the curious pre-auricular pit, are well developed. The eye is black. The rhinarium is naked, brown in colour, and grooved in the mid line. In texture the skin of the rhinarium can only be described as tesselated, the surface being marked out by a series of fine lines into a regular mosaic pattern. The nostrils are cleft laterally.

All vibrissae are well developed. The mysticial set is disposed in 5 rows; the individual hairs are dark at the base and pale at the tips, the longest measure 45 mm. The genal set contains half a dozen long vibrissae. There are 3 supra-orbitals, 8 genals, and a larger number of small submentals. The ulnar carpal tuft contains 4 long pale bristles, and a well marked medial ante-brachial bristle is present.

The manus has naked granular palms; three rather ill-defined pads are present at the bases of digits 2, 3, and 4. The first digit is rudimentary, the second, third, and fourth are well developed and strongly clawed, the fifth small and without a free nail. The large second, third, and fourth digits are fusiform, and taper to their tips without differentiated apical pads. The digital formula is $3 > 2 > 4 > 5 > 1$: the third digit not being greatly in advance of the second.

The sole of the pes is granular and often entirely naked in the adult; in younger examples some hair is present in the mid portion of the soles. Three not very well differentiated pads are present; the first, and smallest, at the base of the syndactylous digits, the other two at the bases of the fourth and fifth digits respectively; these last two being commonly more or less conjoined. The first digit is rudimentary and has no claw, the second and third are syndactylous, the fourth and fifth are

FIGURE 94.—Skull of a South Australian specimen of *Isoodon obesulus*. One and a half times natural size.

well developed and carry strong curved claws. The digital formula is $4 > 5 > 2\text{-}3 > 1$. The pouch opens downwards. The nipples are 8 in number arranged in an incomplete circle. The skull is fairly massive, and the muscular ridges are well marked. (*See* Figure 94.) The bullae are elongated.

DIMENSIONS.

	Typical South Australian Specimen.
	♂
Head and body	340
Tail	120
Hind foot	56
Ear	18

DIMENSIONS OF SKULL.

	South Australian Specimens.			Kangaroo Island.
	♂	♂	♀	♂
Basal length	73	72	62	73
Breadth	34	32	28	34
Nasals, length	28	28	27	31
Palate length	42	42	38	44

It is a regrettable fact that this once familiar little animal is now extremely rare in South Australia. Not very many years ago it was common all over the State; to-day it is on the verge of extinction. It is remarkable and greatly to be deplored that an animal, which was so familiar and abundant in the boyhood of the present generation of South Australians, is likely to cease to exist at all on the south Australian mainland. On Kangaroo Island it still lives in the sanctuary of Flinders Chase, and here it should continue to flourish, its only enemy being the large *Varanus* which is so common on the island.

Although Bandicoots were somewhat unpopular because of their habit of scratching in cultivated land, they are animals that did an immense amount of good, for they possess an untiring energy in searching out and destroying insects. The scratching is done with the object of obtaining insects at the roots of vegetation, rather than for obtaining the roots themselves. For the most part, *I. obesulus* preferred fertile spots where vegetation was abundant, and its elected habitat was therefore the sooner rendered inhospitable by the advent of man with his dogs and cats. South Australia is the poorer for the loss of the Short-nosed Bandicoots, not only because of the great amount of economic good they did as destroyers of noxious insects, but also because they are most engaging and fearless little animals, which are naturally friendly in their disposition, and unsuspicious in their intercourse with man. Most lands are fortunate in possessing some inoffensive animal, which is ready to accept a truce with man, and assume the part of a friendly dependent. Australia has been blessed by possessing an unusual number of such animals, but it is Australia's distinction that almost all of them have been pressed to the very verge of extinction, and one of the most to be regretted is the little Short-nosed Bandicoot. Besides its cheerful assumption of good fellowship with man, the Bandicoot has another attribute which is deserving of respect, and this is its tireless energy. It would be far more appropriate to recommend the sluggard to study the Bandicoot than to urge him to attempt to emulate the ant. So long as a Bandicoot is awake it is busy. It is this very industry that made it unpopular

in the days of its abundance, for it will accomplish an immense amount of scratching in order to secure a beetle burrowed into the earth.

Although nocturnal or crepuscular, as a general rule, it will often spend the whole day in some activity or other, and it appears to be but little handicapped when abroad in bright sunlight. If its nest needs repairing it will work through the hottest day at collecting materials and shifting them to the site of its bed. The nest is constructed by collecting grass and dead leaves, and erecting a mound in a chosen tangle of vegetation. All the herbage around the nest is gathered, grass is scratched up by the roots, and, with infinite industry, a considerable mound is made. The Bandicoot intent on nest building will level off the surrounding vegetation almost as neatly as if a scythe had been over the ground; and for a little while the nest is conspicuous in consequence of the denuded patch of which it forms the central object. After a short time the grass begins to grow, and the material which is gathered for the nest itself, begins to sprout or to germinate from seed, and the nest becomes concealed by its own little thicket of vegetation and is then particularly difficult to detect. No permanent hole is left in the little mound, for the animal burrows in and out at any aspect. Invariably on emerging from the nest it sets about bed making, shaping up the mound and closing over the hole from which it emerged. There is no permanent chamber in these nests; but the animal lies in the middle of the collected material, and if the dome of a newly-made mound is watched, the animal's respiratory movements are easily detected. When it awakes in the evening, a heaving movement is seen in the mound, as though a small earthquake were in progress: the awakened animal breaks out anywhere and immediately starts to repair the damage. Bandicoots seem to have an instinct of the approach of bad weather, for before heavy rain they will add to the nest pile with feverish activity. One that I had in captivity would always leave its open-air nest and retreat to the security of a bed inside a box, and the change of residence was always made in advance of the advent of bad weather.

Bandicoots are desperately pugnacious. An *obesulus* which had been in captivity ever since it was quite small, and which was exceedingly tame, had a much larger *Perameles nasuta* introduced into his run. By morning the *nasuta* was dead and almost entirely plucked. An *Isoodon nauticus* was put into the same run, and it was hoped that the near kinship of the two animals would ensure peace, but the *nauticus* was only rescued in a dying condition.

Their methods of fighting are peculiar. The aggressor will tirelessly follow his victim until he wears it down. Each time they come to close quarters a curious series of little sounds, half-way between a grunt and a squeak, is emitted. This little sound is reminiscent of the noise made by guinea pigs, save that in the one case it is expressive of anger and in the other of contentment. When one animal overtakes the other, and presses it to an engagement, the assault is made by a jump and an endeavour to strike with the claws of the hind feet. Each stroke carried home, removes some hair from the victim's back and scratches the thin skin. This style of fighting may continue for a long while, but, as the less aggressive animal tires, the stronger one will attack with a rapid scrambling motion of its fore feet, inflicting damage by strokes of the strong claws of the manus, the strokes being delivered with lightning rapidity. They seem never to fight face to face,

for when the chase leads to such a meeting one instantly jumps over the other, inflicting a blow with the hind foot in passing, and renews the attack from the rear. Only as a last resort, although the whole encounter has been conducted with open mouths, do they start to bite each other.

The curious rapid scrabbling movement of the fore feet, used in fighting, is also employed in dealing with any living prey, or with any unusual object which is regarded with suspicion. If a living worm, or a dead mouse, is offered to *obesulus* the result is always the same; the animal proceeds to roll and kneed the thing along the ground with rapid strokes of its fore feet. The whole time the fore feet are rolling the object, the animal is steadily retreating, and it continues the curious shuffling movement until it has reduced the body of its victim to an almost shapeless mass. Only then is the object allowed to rest, and after a brief examination is eaten or rejected as the case may be. As a rule, when dealing with mice the process is a prolonged one, and in the end the head alone is eaten. In capitivty Bandicoots will eat almost anything. They prefer cooked meat to raw, and they are especially fond of milk puddings and fancy cakes; but even those reared in captivity prefer beetles and other insects to any man-made delicacies. In ordinary slow progression the fore limbs are moved alternately, and the hind limbs synchronously. In rapid progression the fore limbs move together, and alternately with the synchronously acting hind limbs. Although the Bandicoot never develops a saltatory mode of progression, it possesses a capacity for jumping that would not be inferred from its compact and rather heavy build.

Its great guiding sense is olfactory, and its sense of smell, aided by the tactile sensations imparted by the vibrissae, is its most important faculty in all activities connected with the search for food. Nevertheless, the Bandicoot is by no means such a slave to the sense of smell as are some of the higher mammals; its sensory perceptions may be said to be fairly well balanced. Its vision for near objects is good, even in broad daylight. Its auditory appreciation is also well developed, and in captivity it will readily come to a call at feeding time. It seems to be silent at all times save when engaged in its peculiar methods of fighting

The breeding season is in June, and four young are usually produced at a birth.

(2) **Nuyts' Islands Bandicoot.**

ISOODON NAUTICUS (Thomas, 1922).

An insular form which differs from the Short-nosed Bandicoot of the mainland in directions that commonly distinguish animals living on islands of very restricted area.

On the whole, the animal is distinguished by being smaller, more lightly built, and paler in colour, and by possessing a skull which is remarkably smooth and devoid of muscular impressions. The manus and pes are small, the pads similar to those of *obesulus*. (*See* Figs. 95 and 96.) At first sight the adult insular animal might be taken for a young example of the mainland form; and the skull even that of an old male might be mistaken for that of a young female *obesulus*. The animal was first captured on the islands, by the writer, in January, 1922, and Mr. Oldfield Thomas's description of the type specimen is as follows:—"Size markedly

smaller than in the continental *obesulus*, the skull of an adult male only about 55 mm. in length, as compared with 70 mm. or more in *obesulus*. General colour comparatively pale; under surface white; hands and feet with grey-brown metapodials and white digits; tail brown above, whitish below." Details of rhinarium, vibrissae, ear and eyes as in *obesulus*.

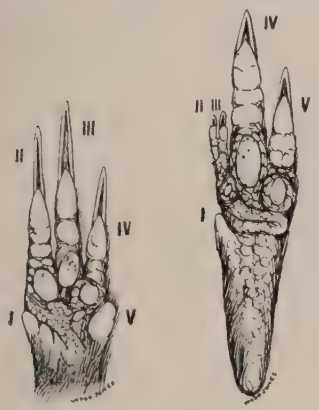

FIGURE 95.—Left manus and pes of *Isoodon nauticus*. Manus one and a half times natural size, pes natural size.

FIGURE 96.—Manus and ulnar carpal vibrissae of *Isoodon nauticus*. Twice natural size.

" Skull far smaller than in *obesulus*, smooth, and almost without cranial ridges, the sagittal crest obsolete, and even the two lateral thickenings of the occipital much less developed than usual. Nasals much shorter and narrower than in *obesulus*. Bullae not nearly as broad as in *obesulus*, but peculiarly shortened, rather abruptly cut off behind. (*See* Figure 97.)

" Teeth small throughout. The three juxtaposed incisors $I.^{2} - I.^{4}$, together about 3 mm., as compared with 4·5 mm. and upwards in *obesulus*. Canines short. Secator and molars all proportionately reduced."

DIMENSIONS.

	Type. ♂	♂
Head and body	242	240
Tail	—	—
Hind foot	50	45
Ear	—	20

DIMENSIONS OF SKULL.

	Type. ♂	♂	♂	♂
Basal length	53	53	51	—
Breadth	25·3	27	25	25
Nasals, length	21·7	20	21	22
Palate length	31	33	30	—

The average interparietal breadth in both *nauticus* and *obesulus* is 12 mm. The very much shorter skull of *nauticus* has therefore a relatively far wider brain case. (*See* Figure 98.)

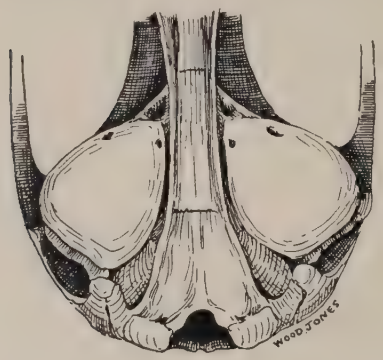

FIGURE 97.—Posterior end of the base of the skull of *Isoodon nauticus* to show the form of the bullae. Twice natural size.

around are little animals moving about, and some of these are Bandicoots and some are the nest-building rat (*Leporillus jonesi*) peculiar to the island. It is by no means easy to tell the one from the other in the twilight, for in size and in colour they are very much alike, but they may be easily distinguished by noting their attitude towards man. The Bandicoots will come right up to the hand for some such delicacy as bread and jam; but the rats take instant alarm when an advance of this sort is made.

In captivity the island Bandicoot displays habits exactly similar to those of its larger mainland relative. On the island it lives in the thick tangles which the strands of *Tetragonia implexicoma* make around low vegetation, and, like the snakes and the rats, it readily avails itself of the shelter of the mutton birds' burrows. Although no nests were found on the island, the animal constructs a nest in captivity. Owing to the density of the Bandicoot population on the island, fights must be very frequent, and only one speci-

This beautiful little Bandicoot lives on two islands in Nuyts' Archipelago. Upon one island, which is inhabited by man, it is comparatively rare, and is certainly doomed to extinction. Upon the other island it exists in large numbers. Its only companions on this island are mutton birds, penguins, nest-building rats, and black tiger snakes: from none of these is it in danger of extermination, and it is much to be hoped that its island sanctuary will long remain inviolate. As soon as it is dark in the uninhabited island, the Bandicoots come abroad in remarkable numbers. All

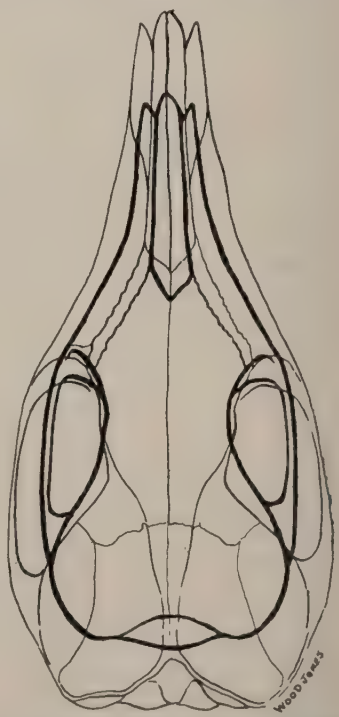

FIGURE 98.—Superimposed outlines of the skulls of *Isoodon nauticus* (thick lines) and *I. obesulus* (fine lines. One and a half times natural size.)

men with a whole tail was captured; all other examples possessed nothing but mere stumps of varying length. Ragged ears are also the rule. It is remarkable how very greatly the males seem to outnumber the females, and no female specimen has yet been captured.

This island is the last place in South Australia where Bandicoots still linger in their former numbers and in their characteristic cheerful fearlessness: it would be a disaster if, through lack of adequate protection, they were permitted to share the fate of the mainland form.

FIGURE 99.—Head of *Perameles nasuta*—the Long-nosed Bandicoot of eastern Australia. Two-thirds natural size.

At first sight it might seem that the name of Short-nosed Bandicoot was inappropriate when applied to the animals belonging to the Genus *Isoodon*. The name is, however, well established, and was bestowed as a distinction from the most familiar Bandicoot of the eastern portion of the continent in which the nose is far longer. (*See* Figure 99.) This animal (*Perameles nasuta*) is a member of the next Genus and does not occur in this State.

GENUS 2.—PERAMELES (Geoffrey, 1804).

The members of this Genus are more lightly built and graceful than those of the Genus *Isoodon*. The coat is smooth and fairly soft, the hair being comparatively

FIGURE 100.—The form of auricle characteristic of the members of the genus *Perameles*.

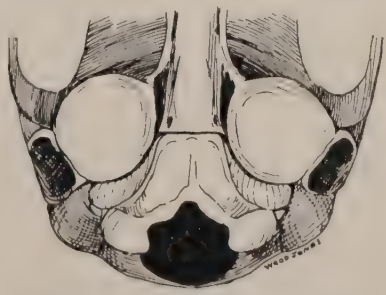

FIGURE 101.—The bulla region of the base of the skull of *Perameles myosura*. Twice natural size.

fine. The muzzle is greatly prolonged, the rhinarium naked and grooved. Ears long, with pointed tips; when laid forward they cover the eye. In texture they are thin and leaf-like. The main processus antihelicis is small; the secondary process elongated and flattened. An elongated bursa and a shallow pre-auricular depression are present. (*See* Figure 100.) The sole of the pes is hairy in its posterior part. Digits and pads as in *Isoodon*.

Dentition, I. $\frac{5-5}{3-3}$. C. $\frac{1-1}{1-1}$. P.M. $\frac{3-3}{3-3}$. M. $\frac{4-4}{4-4}$. Cranium short, nasal region greatly prolonged. Bullae small, round, and complete. (*See* Figure 101.)

Two species inhabit South Australia.

KEY TO THE SOUTH AUSTRALIAN SPECIES.

(A) General colour brownish-grey, boldly banded across the loins with black bars.
P. myosura.

(A[1]) General colour dull orange, no bars across the loins.
P. eremiana.

(1) South Australian Barred Bandicoot.

PERAMELES MYOSURA (Wagner, 1841).

An explanation must be made concerning the nomenclature here employed, and this explanation must embrace both the popular and the scientific name. The animal is often named the "striped" Bandicoot. Throughout this series of volumes the term "stripe" is used only for a longitudinal marking; by stripe a mark elongated in the long axis of body is indicated. Lines which encircle the body, on the other hand, are indicated as bars or bands. In order to retain a consistent nomenclature this animal is therefore termed "barred," and not "striped" Bandicoot. With regard to the scientific name, the animal has long been known as *Perameles bougainvillei*, or as *Perameles bougainvillei fasciata*, but here we revert to an older usage, and *bougainvillei* is reserved as the name for the animal living on Peron's Peninsula, in Shark's Bay.

Peram les myosura is a lightly built, graceful little animal, with slender manus and pes. The muzzle is much prolonged, the ears are large and held erect; the coat is strikingly, almost brilliantly, marked. The general colour is a rather warm, grizzled, brownish-grey. The hair is long, and though each individual hair is spine-like, the coat is soft to the touch. The under fur is grey in colour and is abundant, especially towards the hind end of the body. The muzzle, face, and head finely grizzled fawn; some of the hairs being yellow, and some being black at the tips. The dorsal surface of the anterior portion of the body grizzled grey-brown, becoming darker as it is traced backwards, by reason of more of the hairs being black tipped. This colouration ends in the hinder part of the costal region, and is succeeded by a paler band of pure fawn, which in turn is followed, in the

mid dorsal line, by a black area over the loins. From this black area three black bars emerge and radiate downwards over the sides of the body. The first bar, which is the most conspicuous, descends to the front of the thigh ; the second to the middle of the thigh ; and the third to the back of the thigh. The intervals between these bars is pure, or slightly grizzled fawn, considerably lighter than the colour of the anterior portion of the body. The posterior portion of the body is thus marked by alternate bars, which are respectively lighter and darker than the general colour of the anterior portion of the body. The fact that this portion is uniformly coloured, and is darker than the light bars of the posterior portion, led Gould to give the name of " Saddle-backed Bandicoot " to the Western Australian form. In the South Australian animal, the saddle is inconspicuous, and the dark and light bars are the outstanding features of the pattern. (*See* Figure 102.) The boldly marked South Australian form has been given a separate sub-specific name,

FIGURE 102.—*Perameles myosura*. South Australian specimen of the type *notina* from Ooldea. Half natural size.

P. myosura notina (Thomas, 1922), to distinguish it from the Western Australian animal in which the dark bands are indistinct and incomplete The outer side of the limbs is smoky-grey, the fawn colour being conspicuously absent on the outer side of the ulnar region of the forearm, and the fibular region of the leg, which are clothed mostly by the under-fur. The under surface of the chin, throat, and body, and the inner surface of the limbs, pure white. Dorsal surface of manus and pes white. Hair on sole of pes dusky, and hair on under side of wrist dark grey. Tail fairly long, finely taper and clothed with fine hairs. The tail is distinctly parti-coloured, being dark grizzle in the dorsal third of its circumference and white in the ventral two-thirds.

The ears are large, broadened at the base and tapering towards their oval tips. In texture they are thin and membranous. Clothed with minute hairs without ; the anterior portion of the base being rather bright fawn brown, the central portion dark, and the hinder portion dusky and almost naked. Within are sparse white hairs around the margins : the central portion is naked and pinkish-grey in the living animal : the naked portion is punctate with little depressions about the size of a small pin's head. The processus antihelicis is thin and pointed towards its tip, being roughly triangular in shape. The secondary process is elongated laterally. An elongated bursa and a shallow preauricular depression are present.

L

The eye is black and is fringed by fine black eyelashes. The rhinarium is naked and flesh coloured; it is strongly grooved below. The nostrils are cleft laterally.

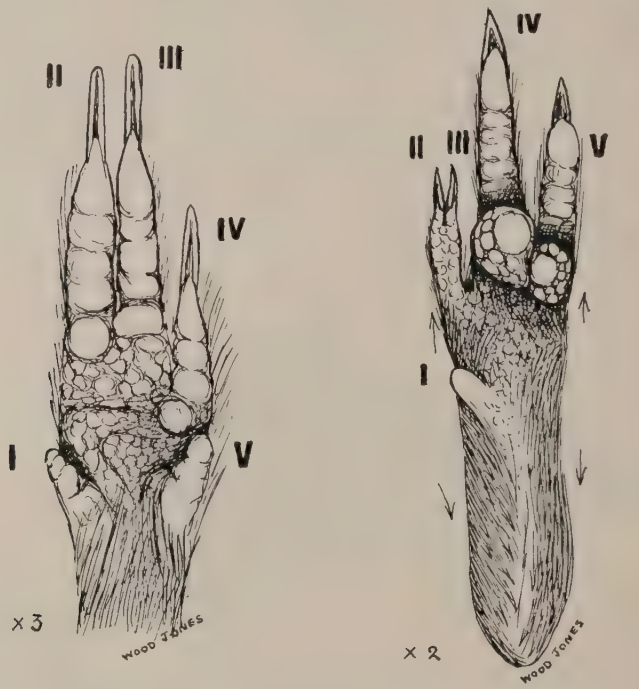

FIGURE 103.—Left manus and pes of *Perameles myosura*. Manus three times, pes twice natural size.

All vibrissae are well developed. The mysticial set is in five rows; the individual hairs are dark in the upper rows and light in the lower ones; the longest bristle exceeding 40 mm. The genal set contains mixed light and dark bristles. The supraorbitals are dark, the genals and submentals white. The ulnar carpal tuft is well developed; the longest bristle in the set being 40 mm.; these vibrissae are all pure white.

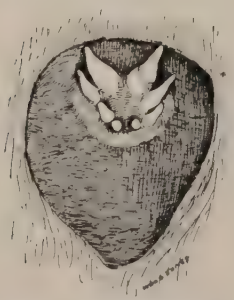

FIGURE 104.—Marsupium and nipples of *Perameles myosura*. Natural size.

The manus has a naked granular palm. The pads are not well defined and are situated at the bases of digits 2, 3, and 4. The first digit is rudimentary, the second and third elongated and strongly clawed, the fourth short but clawed, and the fifth much reduced and having no claw. The digits are fusiform, there are no well developed apical pads. The digital formula is $3 > 2 > 4 > 5 > 1$. (*See* Figure 103.) The sole of the pes is granular, and from the heel to the bases of the

interdigital pads, is clothed with short, dusky, hairs in the central area, and longer white hairs along the margins. At the level of the first digit there is a well marked hair parting, the hairs in front of this line having their free tips directed forwards towards the toes, and the hairs behind it having their tips directed backwards towards the heel. Two well marked pads are present at the bases of the large fourth and fifth digits. The first digit is rudimentary, the second and third are syndactylous, the fourth is very large and carries a strong nail, the fifth though smaller is also armed with a well developed nail. The digital formula is $4 > 5 > 2{\cdot}3 > 1$.

The pouch opens downwards and backwards. The nipples are 8 in number, arranged in a circle which is open in front. (*See* Figure 104.)

The skull is elongated and delicately built. (*See* Figure 105.)

DIMENSIONS.

	Type of Sub-species *notina* (Thos)	♀	♀	♂	♀
Head and body	280	240	215	208	205
Tail	90	85	78	75	75
Hind foot	56	51	47	47	45
Ear	—	42	38	37	35

The type specimen is described as from "plains near the head of St. Vincent Gulf," collected by Capt. Sir George Grey, and by him presented to the British Museum. The other specimens of which measurements are given are from Ooldea, and for all of them I am indebted to Mr. A. G. Bolam.

DIMENSIONS OF SKULL.

	Type of Sub-species *notina* (Thos)	Ooldea.		
		♂	♀	♂
Basal length	66	63	53	53
Breadth	—	27	24	23
Nasals, length	29	27	23	23
Palate length	—	40	33	33

Judging by the specimens enumerated in the British Museum Catalogue of 1888, this beautiful little Bandicoot had at one time a fairly wide distribution in this State. In addition to the animals from the head of St. Vincent Gulf, are others

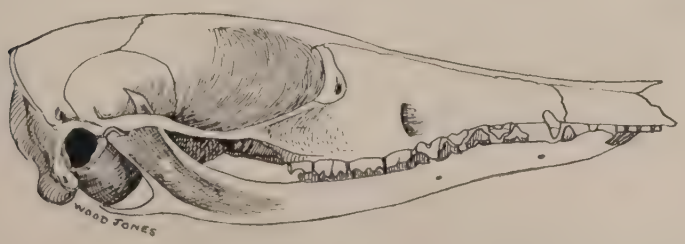

FIGURE 105.—Skull of *Perameles myosura*. One and a half times natural size.

from the River Murray in South Australia, and from Adelaide itself. As far as can be ascertained it has now disappeared from all these localities, and remains only in the wastes of the western portion of the Centre. Its present habitat is the open plains, the level stretches of which are broken only by sandhills and outcrops of limestone; and for vegetation, the blue bush (*Kochia sedifolia*), the salt bush (*Atriplex vesicarium*), and the various stunted desert acacias. On the plains it makes a nest, under a salt bush, similar to those of the Short-nosed Bandicoots, save that it is more given to excavating hollows in which to accumulate its nesting materials. It is mainly insectivorous in diet, and crepuscular or nocturnal in its habits. It is an animal of astonishing activity, its powers of jumping being all the more remarkable from its habit of rising vertically into the air. When alarmed on its evening excursions it will pause, and then, in an instant, spring into the air and vanish in the most remarkable manner. It has few rivals in its ability for disappearing. One moment it is full in view and motionless, and the next it is gone completely. Although the marking of its coat is so boldly contrasted as to create the impression that it would be a rather conspicuous creature, it is, as a matter of fact, one of the most elusive animals and one of the most difficult to detect. When fully active in the twilight its movements are more reminiscent of those of birds than those we usually associate with mammals.

Barred Bandicoots become very tame and familiar in captivity, but although they are extremely gentle when kept as pets, they are desperately pugnacious among themselves. On one occasion eight live specimens were sent from Ooldea. All eight were dead and almost devoid of hair when they arrived in Adelaide. They had fought each other to the death on the railway journey. But among the corpses were four pouch young, which were uninjured. Two of these were males and two were females, the males being one litter and the females another. These little animals were cold and apparently dead; but they were carefully warmed up and given artificial respiration, and in the end they all recovered. The males were reared separately from the females. As they grew older, one female killed the other and one male bit the tail off his fellow. It was hoped to breed from this stock, so, when they were nearly a year old, the remaining female was placed in a run with one of the males. She was rescued almost hairless, and was with difficulty nursed back to life. When she was completely recovered she was placed with the other male, and in the morning he was almost plucked of his hair and, despite careful treatment, died of his wounds two days afterwards. Subsequently this female bred freely with the first male, but always evinced a strong tendency to kill and eat her progeny, even when they were grown to half their adult size. As in the case of *Isoodon*, the fighting is done largely with the long claws of the hind feet: and if the animal is annoyed it will jump at an intruding hand and inflict a sharp scratch with its claws very much in the manner of a game cock. The breeding season is in May and June, and two young are usually born at a time, but I have come across one litter of three.

(2) **Desert Bandicoot.**

PERAMELES EREMIANA (Spencer, 1897).

Size medium; proportions slender. Fur soft with numerous long, dark, spiny hairs on the dorsal surface of the head and body: continued as two dark bands

down each side of the rump. General colour of upper surface dull orange. Margin of upper jaw and under surface of head, together with the whole under surface of the body, white. An orange patch on the shoulders. A patch of dark-grey under-fur on the outer side of the arm and forearm, the rest of the front limb being white. An orange patch on the rump between the two lines of long, black, spiny hairs where the latter are absent. A patch of grey under-fur on the outer side of the hind limb at the lower end of the hinder line of long black hairs. The inner side of hind limb and upper surface of foot white.

Long hairs white at their base, the flattened out part and fine tip being black. Under-fur on the back grey basally, with a white median part and an orange extremity. On the sides of the body the grey is wanting, and on the under surface chin, etc., the orange is also absent. Muzzle fairly long and slender. Ears very long, narrow, and pointed, laid forward they reach 17 mm. beyond the anterior canthus of the eye, grey behind, with a brownish patch anteriorly. Processus antihelicis about as broad as long with a rounded end. A few long, white, whisker-like hairs just above the wrist, the longest measuring 58 mm.

Soles of the hind feet covered with dark-brown hairs up to the pads at the base of the fourth or fifth toes. Tail distinctly bicolour for its whole length ; the upper surface with black (or very dark-brown) spiny hairs sharply marked off from the white hairs of the under surface and side. Nipples eight.

DIMENSIONS.

	♂	♀
Head and body	235	275
Tail	118	135
Hind foot	50·2	55
Ear	51	51

DIMENSIONS OF SKULL.

	♀
Basal length	55·5
Breadth	24
Nasals, length	24
Palate length	36

The above description and measurements are taken from the original description by Sir Baldwin Spencer. In the original, the length of the palate is given as 3·6 mm., but this is an obvious error for 36 mm., and in this respect, therefore, the description has been altered. The original specimens came from Burt Plain, north of Alice Springs, and sandhills about forty miles to the north-east of Charlotte Waters. I know no other records of its capture. Its habits appear to be similar to those of *Perameles myosura* ; it builds a nest in a hollow, scooped out in the sand, and appears to produce two young.

Genus 3. PERORYCTES (Thomas, 1906), Genus 4. ECHYMYPERA (Lesson, 1842), and Genus 5, SUILLOMELES (Allen & Barbour, 1909), are confined to New Guinea and the neighbouring islands, and do not inhabit continental Australia.

Genus 6.—THALACOMYS (Blyth, 1840).

Size larger than that of the members of the preceding Genera. General form light and delicate. (*See* Figure 106.) The pelage is remarkably long and silky. The muzzle is long and pointed and, as a rule, is naked upon its dorsal surface for some distance behind the rhinarium. The rhinarium is narrow, naked, and

Figure 106.—The general characters of a Bilby. An adult male specimen of *Thalacomys nigripes*, about one-third natural size. The end of the tail is represented erect merely for the purpose of compactness of illustration.

grooved only slightly upon its infra-narial portion. The nostrils are slit like. The ears are extremely long, naked, and membranous towards their extremities; the tubular funnel-shaped basal portion being hairy. (*See* Figure 107.) The processus antihelicis duplicated. The pouch opens downwards and slightly backwards. Nipples eight in number, arranged in two crescentic rows. The hind limb considerably longer than the fore limb. The manus with five digits: the first and

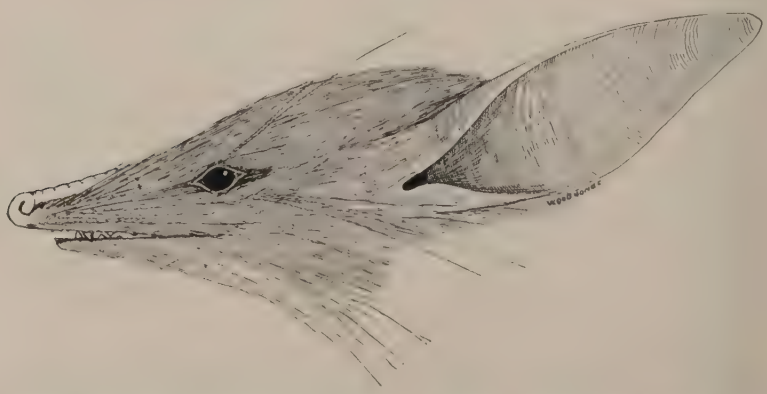

Figure 107.—The characters of the head of a Bilby. Drawn from a living male specimen of *T. nigripes*. Half natural size.

fifth short and clawless, the second, third, and fourth well developed and armed with strong curved claws. The pes with only four digits, the hallux being absent. The second and third digits are syndactylous, the fourth and fifth are well developed and strongly clawed, the fourth being by far the longest. (*See* Figure 108.) The digital formula of the manus is $3 > 2 > 4 > 5 > 1$. The palm is granular, with three small interdigital pads at the bases of the second, third, and fourth digits. The digital formula of the pes is $4 > 5 > 2\text{-}3$. The sole is hairy with the exception of the heel, pad, and terminal portions of the digits. There is one large pad at the

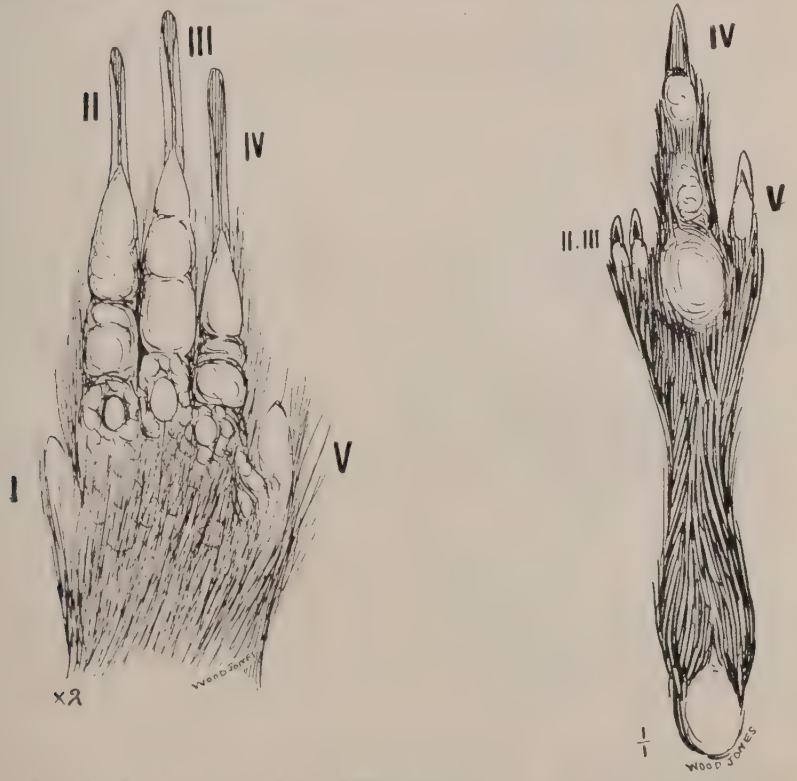

FIGURE 108.—Left manus and pes of *Thalacomys nigripes*. Manus twice natural size, pes natural size.

base of the fourth digit. The tail is long and conspicuously crested in its terminal portion, the actual tip of the tail being naked and hardened into the form of a little spur. (*See* Figure 109.) The facial portion of the skull is abruptly contracted to the snout region opposite the second premolar. The dentition is I. $\frac{3-3}{3-3}$. C. $\frac{1-1}{1-1}$. P.M. $\frac{3-3}{3-3}$. M. $\frac{4-4}{4-4}$ The bullae are large and markedly pyriform. (*See* Figure 111.) There are only five members of this interesting Genus, and all are (or were) inhabitants of South Australia. In habits they seem to be very similar, and, therefore, it is best to give a general account of their economy after the individual species have been distinguished and described.

KEY TO THE SPECIES.

(A) The tail particoloured black and white.

(B) The black portion as long as, or longer, than the white portion.

(C) Size large. Head and body length 400 mm. and upwards. *T. lagotis.*

(C¹) Size small. Head and body length 200 mm. and upwards. *T. minor.*

(B¹) The black portion shorter than the white portion.

(D) Pes white above. *T. sagitta.*

(D¹) Pes black above. *T. nigripes.*

(A¹) Tail wholly white. *T. leucurus.*

(1) Rabbit Bandicoot, Pinkie or Bilby.

THALACOMYS LAGOTIS (Reid, 1836).

This is the animal which, in books, is usually termed the Common Rabbit-Bandicoot, but it would be most misleading to apply the term "common"

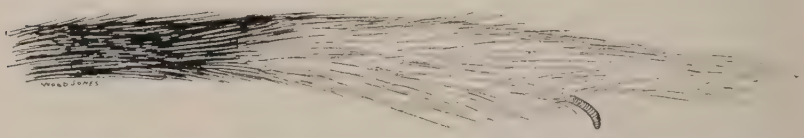

FIGURE 109.—Terminal portion of the tail of *Thalacomys nigripes* to show the naked spur-like tip.

to it to-day. It is considerably the largest member of its Genus, and might, therefore, pass as the Larger Rabbit-Bandicoot or Larger Pilby; but, since it is the only one that has ever had a familiar name bestowed upon it, it is perhaps best

FIGURE 110.—Lateral view of the skull of *Thalacomys lagotis*, from a South Australian specimen. Natural size.

to leave it in possession of the unmodified name, and to distinguish the other members of the Genus from it.

The size is large, the head and body length being 400 mm. and upwards. Fur very long, soft and silky. General colour a delicate smoky grey, being more fawn-grey immediately after the moult. The coat almost wholly composed of under fur, only a few longer hairs, mostly along the mid-line of the back, being mixed with it. Muzzle greatly elongated. Rhinarium flesh-coloured, with the naked pink area extending backwards for 20 mm. along the dorsal surface of the snout. Face fawn-grey, the hair being considerably shorter than the hairs of the body. Cheeks and bases of the ears pale. Chin, throat, ventral surface of the body and inner aspect of the limbs pure white. Outer aspect of limbs grey. A faint indication of bars across the thigh is present in some specimens. The manus is white, the actual digits being at times brownish. The pes is white above; below it is black in its posterior half or rather more. The tail is particoloured black and white, and boldly crested on its dorsal surface. The basal third is clothed with the general body fur; the middle third, or rather more, is black, the hairs being coarse and hispid; the terminal portion (shorter than the black portion) is strongly crested with pure white hairs. The ears are extremely long, nearly naked; their edges finely fringed, and the anterior part of their backs clothed with pale-brown hairs. The eye is black, and is fringed with fine black eyelashes. All facial vibrissae are well developed. The palm and sole, and the digital formula for manus and pes, as described for the Genus. The pouch opens downwards and backwards. The species was originally described as having nine nipples, but eight is the more usual number. The skull is large, basal length being 90 mm. or more. All muscular ridges and crests extremely well marked. (*See* Figure 110.) The posterior (molar) portion of the palate distinctly rounded in outline. (*See* Figures 111 and 112.) The large molars arranged in a crescentic series. The posterior margin of the palate extending well behind the last molar teeth. The posterior palatine vacuities reach from about the central point of the middle premolar to about the central point of the third molar. The nasal bones extend backwards so that their posterior ends almost reach a line joining the lachrymal foramina. (*See* Figure 113.)

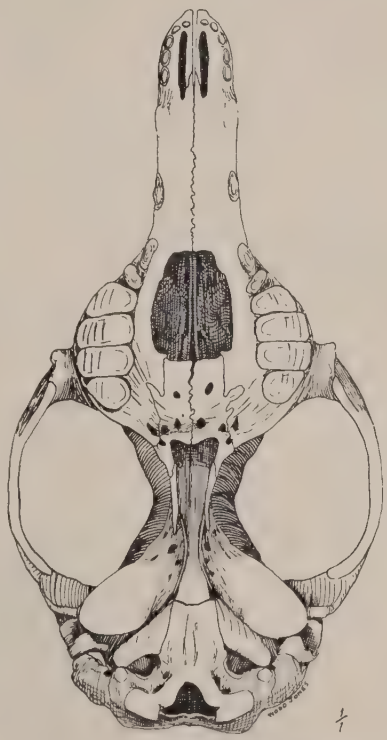

FIGURE 111.—Basal view of the skull of *Thalacomys lagotis*, from a South Australian specimen. Natural size.

DIMENSIONS.

	♂ Nalpa, S.A., Stuffed.	Type ♀ Reid.	Brit. Mus. ♂ Stuffed, W.A.
Head and body	550	462	440
Tail	260	254	220
Hind foot	114	113	98
Ear	77	97	90

DIMENSIONS OF SKULL.

	Nalpa.	Nalpa.	Nalpa.	Gilles Plains.	W.A.	W.A.	W.A.
Basal length	105	104	103	96	94	94	92
Breadth	55	56	55	55	44	50	42
Nasals, length	47	48	50	49	47	47	46
Palate length	66	66	64·5	64	62	61·5	61
C—M⁴	43	44	45	43	45	44	42·5

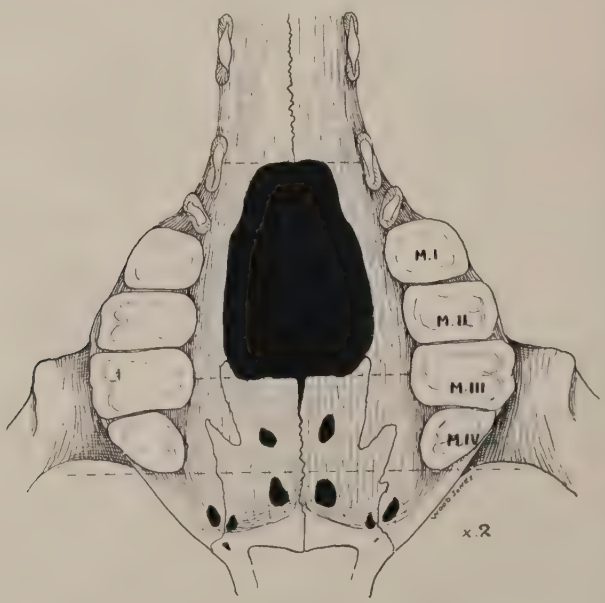

FIGURE 112.—Posterior end of palate and molar teeth of *Thalacomys lagotis*. Twice natural size.

Thalacomys lagotis, though formerly abundant in South Australia, is now either extinct or on the verge of extinction. It was the familiar species of Bilby in the

more fertile portions of South Australia only a comparatively short time ago. Not more than thirty years since it was usual for rabbit trappers, even in the immediate neighbourhood of Adelaide, to take more Bilbies of this type than rabbits in their traps. This race, which is similar to that which still exists in Western Australia, apparently had its last South Australian stronghold at Nalpa and in the wide tract of country about Lake Alexandrina; but from Nalpa it has long since disappeared, and it seems most probable that the animal is now extinct in this State.

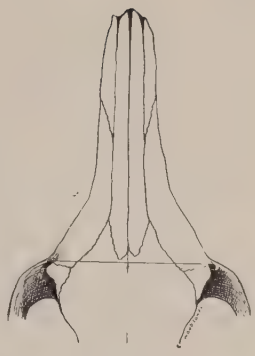

FIGURE 113.—Muzzle of *Thalacomys lagotis* to show the posterior ends of the nasal bones.

(2) Lesser Bilby.

THALACOMYS MINOR (Spencer, 1897).

In outward appearance this animal may be described as being like *T. lagotis*, but slightly darker and considerably smaller, the head and body length being only 200 mm. and upwards. The description of the type specimen is as follows:— Size considerably smaller than *lagotis*. Fur very long, soft and silky; composed almost entirely of under-fur. General colour fawn-grey, but darker than in *lagotis*. Head long, muzzle narrow. Rhinarium naked at the tip of the snout, but no backward prolongation of the naked part as in *lagotis*. Face grey-brown, the under-fur of the face grey basally, then fawn coloured with a dark tip, the longer hairs with a longer black tip. On the dorsal surface and sides of the body the under-fur is black basally, then fawn coloured. The longer hairs very little longer than the under-fur, with a black tip. The hairs of the under-fur very often have a dark-brown tip. Chin and inner surface of fore limbs white, the rest of the limbs and under-surface grey, the fur with dark-grey basal part and white distal half. Manus white. Pes white above, hairy beneath, the hairs on the posterior two-thirds black, the anterior third white. Tail with the proximal two-thirds short-haired. Along thedorsal line is a sharply marked narrow band of dark hair increasing in length distally. At one-third of the length

FIGURE 114.—*Thalacomys minor*. Spencer. Basal view of skull. After Baldwin Spencer, Proc. Roy. Soc. Vict. Vol. IX. (N.S.). Plate II., Fig. 2. Natural size.

from the posterior end the black hairs stop abruptly and are succeeded by a dorsal series of white hairs forming a distinct crest, the hairs of which are proportionately shorter than in *lagotis*. Sides and under surface of tail with scanty stiff white hairs (the black dorsal area of the tail measuring 93 mm., the white terminal portion 67 mm.). Palms and soles, and digital formula of manus and pes, as described for the Genus. The typical eight nipples are present.

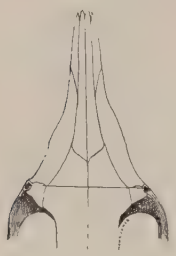

FIGURE 115.—Muzzle of *Thalacomys minor* to show the posterior ends of the nasal bones.

The skull is small and delicate, basal length being 60 mm. or more. Muscular ridges and crests are very feebly developed. (*See* Figure 114.) The posterior portion of the palate slightly rounded, the small molars being in slightly curved rows. The posterior margin of the palate extends well behind the last molar tooth. The posterior palatine vacuities reach from about the central point of the middle premolar to the back of the second molar. The nasal bones extend backwards so that their posterior ends fall short of the line joining the lachrymal foramina by about 5 mm. (*See* Figure 115.)

DIMENSIONS.

	Adult ♀	Adult ♀	Adult ♂	Adult ♀	Adult ♂
Head and body	215	200	245	240	270
Tail	124	118	127	152	160
Hind foot	58·5	57	65	62	73
Ear	71	68	87	85	92

DIMENSIONS OF SKULL.

	♂
Basal length	66
Breadth	34
Nasals, length	32
Palate length	41
C—M^4	28

The description and measurements are taken from the original account by Sir Baldwin Spencer. The measurements of the tail have been added as a result of the kindness of Mr. James Kershaw, who supplied these details from a re-examination of the type specimen. The animal was taken in the sandhills about forty miles to the north-east of Charlotte Waters, but its range almost certainly extends southwards into South Australia.

(3) Barcoo Bilby.

THALACOMYS SAGITTA (Thomas, 1905).

This Bilby, which is the representative of the Genus in the wide area of the Centre that may be described as the Lake Eyre basin, was first made known to science from the mission station at Killalpaninna on the Barcoo or Cooper's Creek.

FIGURE 116.—Lateral view of the skull of *Thalacomys sagitta*. Natural size.

It is intermediate in size between *lagotis* and *minor*; the head and body length being 300 mm. and upwards. In general external characters it is very like *lagotis*, from which it differs only in certain minor, but constant, details. The general body colour is a little paler than is usual in *lagotis*. The manus is white. The pes is white above, but it is dark below in only its posterior third. The white terminal portion of the tail is longer than the black portion. The other external characters are as described for *lagotis*. The skull is fairly large, the basal length being 70 mm. or more. (*See* Figure 116.) The muscular crests are not particularly well developed. The posterior portion of the palate is only very slightly rounded in outline; the molars are arranged in almost straight rows which diverge posteriorly. (*See* Figures 117 and 118.) The posterior margin of

FIGURE 117.—Basal view of the skull of *Thalacomys sagitta*. Natural size.

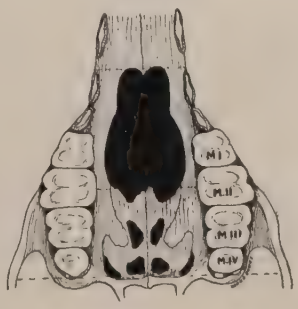

FIGURE 118.—Posterior end of the palate and molar teeth of *Thalacomys sagitta*.

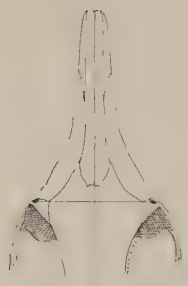

FIGURE 119.—Muzzle of *Thalacomys sagitta* to show the posterior ends of the nasal bones.

the palate terminates at the last molar tooth. The posterior palatine vacuities reach from about the central point of the middle premolar to about the central point of the second molar. The nasal bones extend backwards so that their posterior ends come to within about 4 mm. of the line joining the lachrymal foramina. (*See* Figure 119.)

This Bilby is a northern form living in the region of the great drainage system of Lake Eyre. It is probable that it is still fairly abundant in those portions of this region where foxes have not yet become plentiful, and where it can still compete with rabbits for nesting burrows.

DIMENSIONS.

	Adult ♂ Type Measured by Mr. Hillier.
Head and body	316
Tail	215
Hind foot	91
Ear	79

DIMENSIONS OF SKULL.

	Type.	Coward Springs.
Basal length	76·5	—
Breadth	38	35
Nasals, length	40	37
Palate length	50	49
C—M^4	36	36

(4) **Black-footed Bilby.**

THALACOMYS NIGRIPES (Wood Jones, 1923).

This Bilby is almost the same size as *sagitta*, and, therefore, smaller than *lagotis* and larger than *minor*. It is distinguished from all other members of the Genus by its black manus and pes. In general colour it is much as *lagotis*, being darker and more fawn coloured immediately after the moult, and lighter and more silvery immediately before it. The general body colour becomes darker upon the dorsal surface towards the hind end of the body, the tips of the long hairs of the posterior end of the body being black. At the immediate base of the tail, the dark hairs give way to rather bright fawn coloured ones over a distance of about 30 mm. The naked rhinarium is flesh coloured, grooved on its labial portion, and extending backwards dorsally for about 20 mm. Face fawn coloured. The dorsal area of

the snout immediately behind the naked portion, and as far back as the middle of the eye, is black. Fine black hairs also surround the eye. Sides of the body more fawn coloured than the dorsal surface. Chin, throat, and ventral surface pure white. The hair is directed uniformly backwards on the body, save that there is

FIGURE 120.—Lateral view of the skull of *Thalacomys nigripes*. Natural size.

a reversed gular tract as in the Bandicoots. Fore limb dark as a whole on its outer and upper aspects, white on the inner side and below. The proximal (humeral) portion dark-grey, increasingly dark as it is traced downwards; the fore arm, wrist, and dorsum of the manus black. The black hair stops abruptly over the metacarpus, the digits themselves being white. Just above the wrist, the white of the inner aspect of the fore arm trespasses on to the dorsal surface, making a prominent white patch, about 15 mm. in diameter, on the lower part of the fore arm. The hind limb grey in the whole of its diameter in the tibial portion, save for a narrow strip of white on the dorsal aspect. From the ankle onwards the pes is entirely black, both above and below, save for the presence of a few white hairs over a space of about 5 mm. at the base of the nail of the elongated fourth digit. The base of the tail is fawn colored, the basal area being succeeded by a portion 75 mm. in length, clothed with coarse black hairs, followed by a terminal portion, 85 mm. long, clothed with coarse white hairs which form a conspicuous crest. The terminal dorsal crest projects 40 mm. beyond the tip of the tail. The tail itself ends in a curious hardened spur. (*See* Figure 109.) The ears are enormously long, the auricle consisting of two distinct portions, the basal, tubular, portion clothed in the whole of its circumference with fawn coloured hairs like those of the head and face; this portion measures 25 mm. The terminal leaf-like portion is almost entirely naked, extremely thin, dark-grey in colour, and shining. In the living animal the blood vessels are conspicuous, and, as in some of the Bandicoots, the leaf-like portion of the auricle is punctate with little circular pits about 1 mm. in diameter.

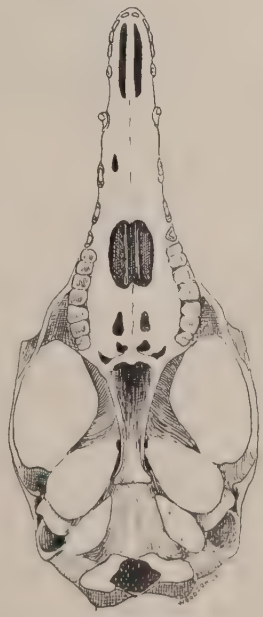

FIGURE 121.—Basal view of the skull of *Thalacomys nigripes*. Natural size.

The naked portion of the ear is 90 mm. in length. The eye is black. The mysticial vibrissae are arranged in five rows, the upper and longer bristles being black, the lower and shorter ones white. The longest measures 50 mm. There are two black supraorbital vibrissae, the one is long (45 mm.) and the other only about half that length. The genal set is represented by a tuft of six vibrissae, of which some are black and some are white; the longest measures 60 mm. The ulnar carpal set is well developed, and consists of three or more strong white bristles, of which the longest is 40 mm. The pouch is well developed, it extends further in front of the opening than it does behind. The nipples are eight in number. The skull is, in its general characters, much as in *sagitta*, but from that form it is very readily distinguished in several details. (*See* Figure 120.) The muscular ridges are but little marked, the skull is lightly built, and the muzzle is extremely elongated and narrow. The posterior ends of the nasal bones are separated from

FIGURE 122.—Posterior end of palate and molar teeth of *Thalacomys nigripes*.

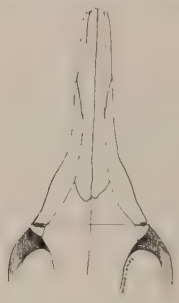

FIGURE 123.—Muzzle of *Thalacomys nigripes* to show posterior ends of nasal bones.

the line joining the two lachrymal foramina by an interval of 5 mm. (*See* Figure 123.) The palate is greatly elongated and extends for a distance of 3 mm. behind the last molar teeth. The posterior portion of the palate is slightly rounded, the molars being arranged in two slightly crescentic rows. (*See* Figures 121 and 122.) The posterior palatine vacuities are peculiarly small, and they extend from the mid point of the middle premolar only to the anterior margin of the second molar. The small size of these vacuities constitutes a very striking, and very constant, distinction of the species. The teeth are small, the molars in particular being considerably smaller than those of *sagitta*.

DIMENSIONS.

	Type ♂.	♂	♂
Head and body	390	365	320
Tail	200	220	210
Hind foot	98	96	92
Ear	105—90	110—97	103—90

Two measurements are given for the ear, the first being the dorsal and the second the ventral measurement.

DIMENSIONS OF SKULL.

	Type ♂.	♂
Basal length	81	80
Breadth	35	32
Nasals, length	40	33
Palate length	50	48
C—M^4	37	34·5

This animal is, so far, only known from the district round Ooldea Soak, on the railway from Port Augusta to Perth. In that district it appears to be by no means uncommon. As with some other members of the *Peramelidae*, there seems to be a great preponderance of males. Its actual area of distribution cannot be determined without careful collecting in the great western spaces of the Centre.

The animal was made known to science through the enthusiastic researches of Mr. A. G. Bolam, of Ooldea, to which gentleman South Australian science is indebted for his efforts in preserving specimens of a vanishing fauna.

(5) White-tailed Bilby.

THALACOMYS LEUCURUS (Thomas, 1887).

This animal is known only from a single specimen which is not adult. Despite the unsatisfactory nature of the material, there can be no doubt that this is a very distinct and very striking form of Rabbit-Bandicoot.

Size small, form slender. Fur long, soft, and silky. General colour pale yellowish fawn. Head long, muzzle narrow; naked rhinarium confined to the extreme tip of the snout, and not extending backwards along the top of the muzzle. Ears when laid forward reaching beyond the tip of the muzzle, evenly clothed with fine silvery hairs, which form a delicate fringe round their edges; their substance yellowish flesh-colour, except for their posterior half distally, where it is slate-grey. Processus antihelicis large, oblong, its edges slightly concave, its tip broadly rounded, hairy; the long secondary lower fold also with a small triangular projection at its centre. Top of head and back fawn, suffused with slaty-grey, the hairs slate coloured at their bases and tipped with brown. Chin, chest, sides, and belly pure white. Limbs wholly white throughout. Palms hairy on their centres, and fringed round their edges, naked only along the undersides of the toes and on the pads; there is a single well-defined circular pad at the bases of each of the second, third, fourth, and fifth fingers, and another below the middle phalanx of the second, third, and fourth. Soles similarly hairy and fringed, only naked on the compound terminal projection, on which there are two small round pads, and on the underside of the fourth and fifth toes. Tail about as long as the body without the head, wholly white, slender, tapering, short-haired except along its terminal third above, where a prominent white crest is formed, of which some of the hairs attain to about one inch in length. Skull small and delicate.

DIMENSIONS.

	Type a very young ♂.
Head and body	142
Tail	116
Hind foot	55
Ear	63

DIMENSIONS OF SKULL.

Basal length	45
Breadth	22·5
Nasals, length	18
Palate length	27·7
C—M⁴	—

The only specimen which has ever been examined was sent in 1887 by Mr. Beazley (who was at that time taxidermist in the South Australian Museum) to the British Museum. The above description is taken from Oldfield Thomas's account of this unique specimen. Although the precise locality from which this example came is not recorded, it was probably the northern part of this State.

In South Australia the members of the Genus *Thalacomys* were usually known as Pinkies, or in some districts as Pintoes. It is said that the name Pinkie was given to them in allusion to the naked flesh-coloured region of the snout; but the name is also used to designate the Short-nosed Bandicoot in certain parts of South Australia. In the Centre, Rabbit Bandicoots are commonly known as Thulkas, or Talkies, which is the white man's rendering of the name in general use among the Kukata blacks. Further into Western Australia the name changes to Dalgheites, Dalgites, or Dulgites. All these names are, however, somewhat local in their usage. The most general name by which the animals seem to have been known to the colonists in all States is Bilby. Special native names have been applied to the different species. Urpila is the name used by the Charlotte Waters blacks for *T. minor*; the Diari name for *T. sagitta* is Kapita, while Urgata is the name given to the same animal at Charlotte Waters.

In general, the bionomics of all the species may be taken as being similar, and in the following notes the individual species will not be separately mentioned unless it is known that their habits differ in some respects. Observations on wild specimens mostly relate to *T. sagitta*, whilst those observed in captivity have been T. *lagotis* and *T. nigripes*.

By the early colonists the Bilby was not only regarded as an animal against which the methods of the exterminator need not be employed; it was even accorded a certain amount of protection, and was at times kept as a pet about the house. The tolerance with which it was regarded by people whose hands may be justly said to have been against all animals was due to the fact that it was recognised that, in the destruction of mice and insects, it played an extremely useful part. Unfortunately this regard for the Bilby seems to have been forgotten by a later

generation, and in more recent days but little mercy has been shown to them by any section of the community.

The diet is commonly said to be "bulbous roots" (Krefft), "grass, fruits, and insects" (Lydekker); but I doubt very much if any of the species is at all given to eating roots, grass, or fruits. It is true that in districts where they live it is common to see little holes scratched around the roots of vegetation, but it is very doubtful if these are made in order to obtain roots. It seems much more likely that insects are the object of the search. In captivity I have been unable to persuade them to eat roots or fruit: but bread or cake, meat (raw or cooked), insects, snails, birds, and mice are all readily eaten.

The members of the Genus *Thalacomys* differ from the rest of the *Peramelidae* in their truly fossorial mode of life. *Isoodon* and *Perameles* will scratch out shallow runways, but none of the species with which I am acquainted ever excavates real burrows in which to live. *Thalacomys*, on the other hand, passes most of its time in the depths of a burrow of its own making. These burrows are still to be seen in some numbers in certain districts on the route of the Transcontinental Railway from Port Augusta to Perth, and in the Stuart Ranges. The typical burrow, as it is excavated in these districts, is easily identified, not only from the track of the animal and the characteristic mark made by its tail, but by the actual construction of the burrow itself. Unlike many burrowing animals, it does not make an exit and an entrance hole. The burrow has a single opening, and from the mouth it descends with a fairly steep, but ever opening, spiral to a depth of five feet or more. The spiral construction seems to be universal, and the work involved in digging out a burrow is very considerable, for the animal by no means always selects those spots where the soil is loose, as Waterhouse affirms. According to Sir Baldwin Spencer, *T. minor* differs from the other members of the Genus in that "during the winter months it lies within a foot or so of the entrance of its burrow, and only uses the inner chamber during the summer." *T. sagitta*, *T. nigripes*, and *T. lagotis* seem to occupy the furthest recesses of the burrow at all times, and it is necessary to dig them out, whereas the blacks capture *T. minor* by stamping in the burrow behind it.

Not only does *T. sagitta* spend the whole day at the bottom of its burrow, but in the region to the west of Lake Eyre, where alone I have field experience of it, it spends the whole of the cold weather, for it does not come abroad in the evenings of the short but sharp winter.

It is a feature not confined to the burrows of *Thalacomys*—for the homes of many creatures which live underground in the arid Centre show the same characteristic—that though maybe a barrow load of earth must have been removed in the excavation, the mound of debris at the entrance consists of no more than a bucketful.

By Krefft it is said not to be so ferocious as its large canines would lead one to suspect. To a certain extent that it true, and the animal can only be described as being extremely inoffensive. Nevertheless, all those with which I have had to deal have needed the exercise of considerable caution in their handling. They bite readily and savagely when interfered with, and, though the bite may not be very severe, it is aggravated by the fact that the animal will not readily let go, and effects multiple bites from a single hold.

Bilbies are strictly nocturnal and come abroad at a later hour than any other marsupials that I have observed. Those I have had living in captivity (in a large open-air run) have often been noticed to appear at dusk but, after a hurried look round, retreat to bed again and not reappear for an hour or so. They seem, however, to have no objection to moonlight. During the day time they sleep in a remarkable posture and they do not, as a rule, lie down on their sides as most animals do. The long ears are laid back, and then folded forwards against the side of the head so that the tips come forward over the eyes and alongside the snout. The animal then squats on its hind legs and tucks its long snout between its fore legs, so making itself into a round silky ball; the tail being usually bent forwards between the legs, or protruded straight behind it.

When the animal wakes in the evening, it often starts its perambulations with one ear laid back and the other still doubled forward in the sleeping position. It is curious that, though the ears are kinked flat upon themselves for the greater part of the time, there is no indication of a crease, or folding line, where the flexure takes place.

In any gait the hind limbs move together. In slow progression the fore limbs move alternately; in more rapid movements they move in unison, but alternately with the synchronously acting hind limbs. Waterhouse noted of one which lived in the gardens of the Zoological Society of London that—" when walking the hind legs only were used, and these were very widely separated. The tail assisted slightly in supporting the body, which was but little raised in front." I cannot help thinking that this is an erroneous observation. It is quite true that the hind legs are widely separated, and that the body is but little raised in front; but I do not think that the animal ever progresses on its hind legs alone in true saltatory fashion. It can make a good pace, though its progress always appears to be shuffling and somewhat ungainly. Its greatest safeguard is its aptitude for digging itself in, and the speed with which it can make for the shelter of its burrow.

In almost all published figures, and in most mounted specimens, the animal is represented as standing far too high on its legs. Such figures as Lydekker's Monotremes and Marsupials, 1894 (Plate XX), and the mounted specimen photographed by Lucas and Le Souef, Animals of Australia, 1909 (Figure p. 137) give very incorrect postures for the animal.

The toilet of the long silky hair is very elaborate, and it is performed as usual by the synadactylous pedal digits: the manus remaining unemployed. An animal, which had suffered the loss of a hind leg in a rabbit trap, made vigorous attempts to scratch itself with the short stump, but it never attempted to replace the office of the absent member by the employment of its hands. The change of pelage takes place twice a year, in February and September, and is a prolonged affair. The new coat first appears upon the head, and slowly spreads backwards over the shoulders and along the back. There is a very sharp line of division between the old coat and the new, for the new hairs remain for a long while considerably shorter than the old, and they are distinctly more warmly coloured; the old coat appearing long and silvery, and the new coat short and fawn coloured.

The main guiding sense is olfactory, and, during daylight, at least, the power of vision appears to be by no means acute. A grasshopper, even though it be actively moving, is detected in the daytime by scent before it is detected by sight.

When active in the dark the auditory sense is evidently very keen, and although Bilbies will take no notice of a person who remains quite still, they will detect a distant footfall with remarkable quickness. They appear to produce no vocal sound save an inspiratory hiss when disturbed.

In normal seasons the young are born from about March to May, and one or two constitutes the usual litter. In the Centre the breeding season is regulated more by the rains and the abundance of food than by the actual period of the year.

The reason for the rapid decrease in numbers of the Bilby is not quite obvious. Certainly these useful animals have been ruthlessly slaughtered in all districts within reach of the more settled areas. Their pelts have been marketed in the skin sales in Adelaide in very large numbers; and they have been more wantonly killed for "sport." Large numbers have been killed or maimed in steel traps set for rabbits, and possibly many have fallen victims to poison baits. As with all the more defenceless marsupials, the introduced fox has probably played its sinister part. But in the Centre, where the fox is still absent, or rare, and where the Bilby is but little molested by man, it seems that some other factor must be invoked; and this is probably the extraordinary abundance of rabbits, and the consequent struggle for breeding burrows. There is certainly no part of this State where the Bilby is not a rapidly disappearing animal.

Genus 7.—CHOEROPUS (Ogilby, 1838).

So far only one member of this Genus has been described, and this remains an exceedingly rare animal. The form is light and slender. The muzzle short and narrow. Nose sharp and pointed, the naked rhinarium confined to the extreme tip. Ears very long; processus antihelicis duplicated as in *Perameles*, the projection of the superior process short but broad. (*See* Figure 124.) Pouch opening

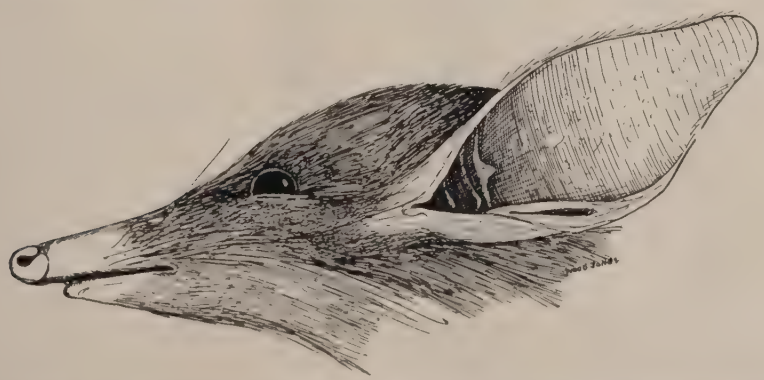

Figure 124. Characters of head and ear of *Choeropus castanotis*. Natural size. From a male specimen from Ooldea. South Australian Museum.

backwards: nipples eight. Fore limbs long and slender. Fore feet with the first and fifth digits entirely wanting, the fourth minute, rudimentary, and only reaching to the middle of the metacarpus of the third; the second and third digits

alone fully developed. Hind limbs long and thin. The hallux entirely absent, fifth digit short and rudimentary, the large fourth digit composing the whole bulk of the foot. The small second and third digits syndactylous. Soles hairy, a small naked pad at the base of the fourth toe. Tail long, boldly crested along its upper surface. Skull broad and flattened, with a short narrow muzzle. (*See* Figures 126 and 127.) Bullae small, rounded, and complete. Dentition I. $\frac{3-3}{3-3}$. C. $\frac{1-1}{1-1}$. P.M. $\frac{3-3}{3-3}$. M. $\frac{4-4}{4-4}$.

Choeropus may be regarded as a specialised cursorial offshoot of the plains-inhabiting members of the Genus *Perameles*. Only one rare and interesting species is comprised within the limits of the Genus, this species being an inhabitant of South Australia.

Pig-footed Bandicoot.

Choeropus castanotis (Gray, 1842).

The scientific name which was first bestowed upon this animal by Ogilby, its original describer, was *Choeropus ecaudatus*. This name was given to it because the original specimen captured by Major Mitchell in 1836 had lost its tail, doubtless in consequence of fighting. The fact that the animal was originally described as having no tail led to a rather curious incident, for Krefft, in his anxiety to obtain specimens of the tailless animal that Major Mitchell had described, offered high rewards to the natives of the lower Murray. The result, in Krefft's own words, was that "the cunning natives, not succeeding in finding the animal required, were in the habit of bringing any number of the common Bandicoot with the tail screwed out." Since the name *ecaudatus* (or tailless) is quite inappropriate for an animal which normally has a long tail, it has been generally replaced by the more appropriate name of *castanotis* (or chestnut eared) given to it by Gray.

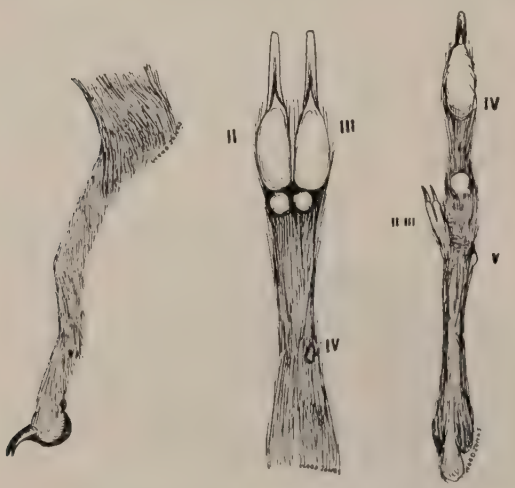

Fig. 125.—Left fore limb, manus and pes of *Choeropus castanotis*. Fore limb and pes natural size, manus twice natural size. Male specimen from Ooldea, South Australian Museum.

Size small, form delicate. Hair coarse but not spiny, coat texture not unlike that of *Perameles myosura*. Under-fur abundant, slaty-grey at the base, dull yellow at the tip. General colour of the head and body uniform grizzled light,

almost orange-brown colour. Ears long and narrow, their outer margins slightly concave just beneath the tip; thinly haired; their backs dull chestnut-brown, darkening towards the tips. Processus antihelicis short and broad. Longer hairs of head and back brown tipped; under-fur yellow tipped. Chin, chest, and ventral surface of body light fawn. Limbs long and slender; short-haired, pale-grey or white with a yellowish tinge. Palms wholly hairy, except on the terminal pads of the two well developed digits; these (second and third) with long slender claws; the rudimentary fourth digit is a mere horny tubercle. Pes very long and narrow, hairy except just below the heel, on the small circular pad at the base of the fourth digit, along the underside of that digit, and on its very large terminal pad. (*See* Figure 125.) Tail more than half the length of the body, with a terminal crest which, on the dorsal aspect, commences at about 70 mm. from the tip.

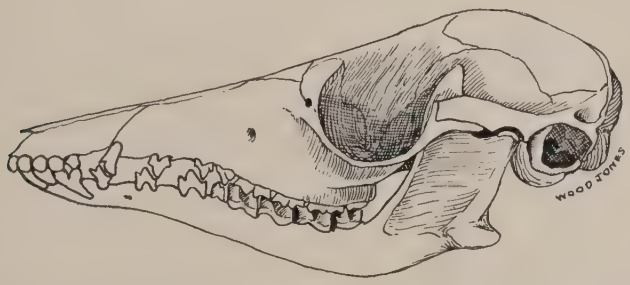

FIGURE 126.—Lateral view of the skull of *Choeropus castanotis*. One and a half times natural size.

Towards the base of the tail the hairs of the crest are dark-brown, but at the tip, where they measure 22 mm., they are white. On the ventral surface there is also a smaller crest of white hairs, commencing at about 30 mm. from the tip and reaching a length of 12 mm.

Pouch opening downwards and backwards. Nipples eight in number.

The skull is remarkable for its great breadth across the eye sockets and its short but narrow muzzle. (*See* Figures 126 and 127.)

DIMENSIONS.

	Adult ♀. Stuffed. Brit. Mus., N.S.W.	Adult ♀. Spirit. Spencer. Charlotte Waters.	Adult ♂. Spirit. Ooldea. S.A. Mus.
Head and body	250	230	240
Tail	c100	139	130
Hind foot	69	69	63
Ear	52	54	60

DIMENSIONS OF SKULL.

	Adult ♀. Brit. Mus., N.S.W.	Ryan's Well. S.A. Mus.
Basal length	53	57
Breadth	31	32
Nasals, length	22·5	24
Palate length	36·5	37
C—M^4	—	22

The great interest attached to the Pig-footed Bandicoot lies in the modifications to a cursorial life which find expression in the structure of manus and pes. In the manus there are two functional digits, and in the pes only one developed for the purpose of progression and support. The manus is therefore assuming the condition of the cloven-hoofed (artiodactyle) Ungulates; but with the difference that in the Pig-footed Bandicoot the functional digits are the second and third, whereas in the pig they are the third and fourth. The pes in a like fashion is mimicking the condition of the solid-hoofed (perissodactyle) Ungulates, but again with the difference that in the horses the functional digit is the third, whereas in *Choeropus* it is the fourth. By convergence, the manus and pes have come to resemble the fore feet and hind feet of other animal types, but the elements which are employed to produce this general rough similarity are different in the two cases. The beginnings of the beautiful adaptations which culminate in the production of the manus and pes of *Choeropus* can readily be seen in such a form as *Perameles myosura*. Comparison of Figures 125 and 103 should be made; and it will be noticed that the *Choeropus* type of manus and pes may be considered as exaggerations of the *Perameles* condition, just as the condition of *Antechinomys* (Figure 77) exaggerates that of *Sminthopsis* (Figure 71). Both are adaptations of the feet in animals living in open plains, the one a cursorial and the other a saltatory type.

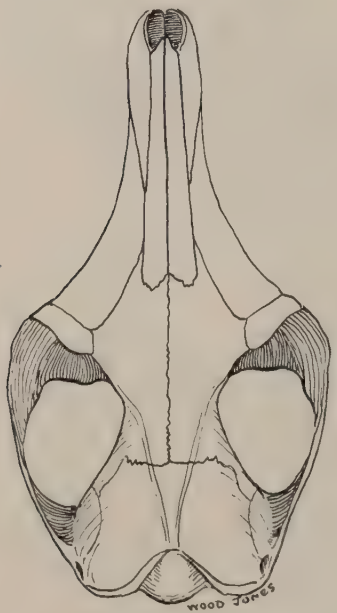

FIGURE 127.—Dorsal view of the skull of *Choeropus castanotis*. One and a half times natural size.

The gait of *Choeropus* was described by Krefft as like that of a "broken-down hack in a canter, apparently dragging the hind quarters after it." I know no more precise account of the sequence of movement of the limbs, and but few white men have been fortunate enough to observe the living animal, for almost all the specimens that have been procured have been captured by the blacks.

Although a very rare animal, the Pig-footed Bandicoot has an extremely wide distribution in the Centre, and it inhabits the interior portions of Queensland, New South Wales, South Australia, Western Australia, and Northern Territory.

Major Mitchell's original, and tailless, specimen was captured on the Murray plains; but from the place of its original finding it seems to have disappeared long ago. Specimens in the South Australian Museum come from Cooper's Creek, from near Ooldea, and from the Gawler Ranges. Probably it still lives in the neighbourhood of Ooldea, but specimens have not been met with in that district for some years. Sir Baldwin Spencer procured examples from Charlotte Waters in 1895. In 1920 one was killed between Miller's Creek and Coward Springs to the south and west of Lake Eyre, but unfortunately no part of the specimen was preserved. Although its distribution in the Centre is wide, it has always been a very rare animal, and now must be regarded as a disappearing one.

The animal constructs a nest very much after the fashion of *Perameles myosura*, and it was met with as a rule by men who were droving cattle, the animal being disturbed by the tramping of the beasts.

It appears to be by no means strictly nocturnal, and on several occasions has been seen in the open in broad daylight. In diet it is omnivorous; such things as grass, barley grass, lettuces, tender leaves, bulbous roots, grasshoppers, and bread are mentioned as having been eaten, but Sturt noted that it showed a much greater partiality for flesh, although it did not flourish on this diet. Doubtless it would be easy to keep healthy in confinement on a diet such as that acceptable to *Perameles myosura*. Pig-footed Bandicoots are said to squat in the open with their ears laid back very much after the manner of little rabbits, and when chased by dogs, to seek the shelter of hollow logs or hollow trees. In the districts to which they are now confined they would be hard put to to find a log, let alone a tree; and the only living specimen of which I have had a first-hand account was noticed dodging about among the saltbush in full daylight. Once open country of this type has been invaded by the fox, the fate of *Choeropus* is sealed. Two young are produced at a birth, and the breeding season is in June. Nothing is known of its sensory perceptions, or of the intimate details of its life history, although as an anatomical type it has been fairly well studied. The name by which it is known to the Kukata blacks is Wilalya, and they regard it as an animal which has always been rare and which is now extinct in their country.

Section II.—SYNDACTYLA DIPROTODONTIA.

In this section are included the marsupials which have the second and third pedal digits bound together, but have lost the full set of little front teeth typical of the first section of the Syndactyla and the whole of the Didactyla. In the present group the number of front teeth is reduced, and the size of the individual teeth is increased, a change which is usual in herbivorous animals. (*See* Figure 128.) Although the front teeth are not by any means always reduced to two, the term diprotodont is conveniently applied to them; and it must be understood that the animals here termed Syndactyla diprotodontia are the Diprotodontia (as opposed to the Polyprotodontia) of those classifications in which the characters of the teeth are given precedence of the characters of the pes in taxonomic importance. The

Syndactyla diprotodontia comprises the didelphian animals which are most typically marsupial; that is to say, they are the most completely specialised members of their phylum. They are herbivorous, arboreal, saltatory cursorial, or fossorial animals; all of rather low intelligence, and some distinctly phylogenetically senile. The pouch is well developed in all, and they may be said to be perfected marsupials, the high water mark of marsupial specialisation, and, therefore, proportionately sundered from the primitive mammalian type.

Within the section there is embraced a rather wide variety of types, the classification of which has always proved to be a somewhat difficult problem. Such

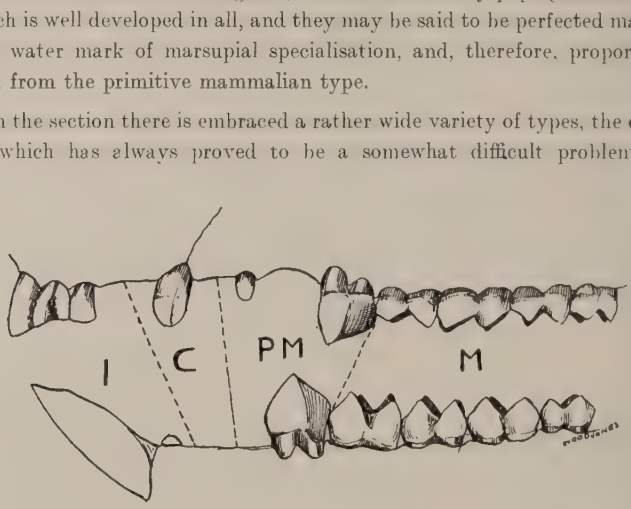

FIG. 128.—A diprotodont type of dentition as it is present in an opossum (*Trichosurus vulpecula*). This figure should be compared with Figure 5 in Part I., where the polyprotodont type of dentition of *Isoodon obesulus* is illustrated.

apparently diverse forms as the opossums, the koala, the wombats, and the kangaroos, wallabies, and rat kangaroos, have to be accommodated in the classification. Many schemes have been put forward, and there is a distinct modern tendency to overcome the difficulties by increasing the number of families within the group. These more recent systems will not be adopted here, for some of them have been founded upon an insufficient first-hand acquaintance with a wide series of types of the marsupials, and they very commonly show a tendency to elevate into family rank some one type which happens to have been more or less exhaustively, but not comparatively, studied. Here the phylogenetic researches of Bensley will be taken as the main guide in classification, and the temptation to create separate families for the reception of somewhat divergent forms will be resisted as far as possible.

In the first place, there can be little doubt that the opossums, or phalangers, form a basal or central group which represents the nearest approach to the primitive arboreal stock of the diprotodonts. This group is distinguished as the *Phalangeridae*. Then again there is the well defined assemblage of saltatory terrestrial forms, of which the kangaroos may be taken as the most perfected type, and this group is known as the *Macropodidae*. Lastly, the wombats form a divergent group which, though having obvious linkages to certain of the arboreal forms, is sufficiently distinct to constitute a separate family, the *Phascolomyidae*. Considered, therefore,

in a simple and conservative way, the Syndactyla diprotodontia may be divided into families as follows :—

(A.) Upper incisors at least 2—2. Molar teeth rooted.

(B.) Pes short, with a well developed first digit, which is often opposable. The masseteric fossa shallow.

Family I. *Phalangeridae.*

(B¹.) Pes elongated, usually lacking the first digit. Masseteric fossa deep.

Family II. *Macropodidae.*

(A¹.) Upper incisors only 1—1. Molar teeth unrooted.

Family III. *Phascolomyidae.*

[The masseteric fossa is the name given to the depression upon the outer side of the lower jaw into which the masseter muscle is inserted. The fossa is illustrated at Figure 129.]

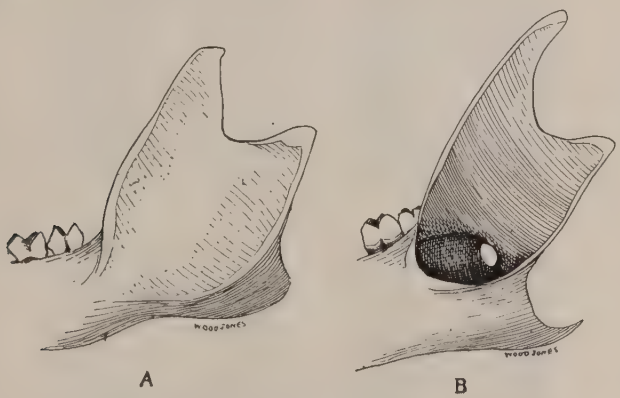

FIGURE 129.—The posterior part of the lower jaws of (A) a member of the Family Phalangeridae (*Trichosurus*) and (B) a member of the Family Macropodidae (*Bettongia*), to show the shallow masseteric fossa in the first and the deep fossa in the second.

Of these three Families the first is the most primitive in the general characters of its members, and it embraces the Opossums, Ring-tailed Opossums, Flying Opossums, Dormouse Opossums, Cuscuses, Koala, and *Tarsipes*. It is most conveniently divided into Sub-families as follows :—

FAMILY I.—PHALANGERIDAE.

(A.) With cheek-teeth well developed ; tongue short and not extensile.

(B.) Digits 1 and 2 opposable to the remaining digits. Molar teeth with crescentic cusps. (*See* Figure 130.)

Sub-family 1. *Phascolarctinae.*

(B¹.) Digit 1 alone opposable to the remaining digits. Molar teeth with mound-like cusps. (*See* Figure 130.)

Sub-family 2. *Phalangerinae.*

(A¹.) With cheek-teeth degenerate ; tongue elongated and extensile.

Sub-family 3. *Tarsipedinae.*

Sub-Family 1.—PHASCOLARCTINAE.

Division of the Sub-Family into Genera.

(A.) Tail well developed. With small teeth present between the canine and the last premolar.

(B.) Without a flying membrane.

Genus 1. *Pseudochirus.*

(B¹.) With a flying membrane.

Genus 2. *Petauroides.*

(A¹.) Tail rudimentary. No small teeth between the canine and the last premolar.

Genus 3. *Phascolarctus.*

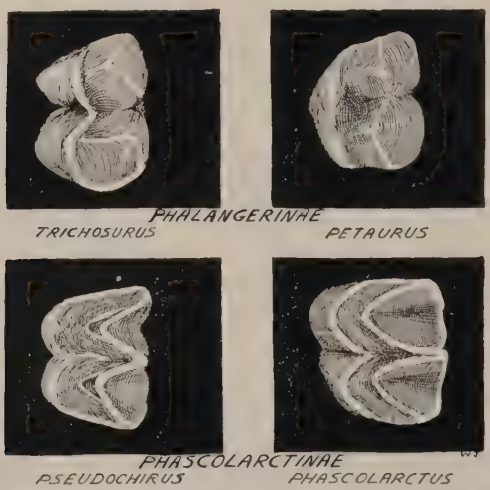

Figure 130.—The first left upper molar tooth of two members of the Sub-family *Phalangerinae* and two of the Sub-family *Phascolarctinae* to show the mound-like (bunodont) cusps in the former, and the crescentic (selenodont) cusps in the latter.

Genus 1.—PSEUDOCHIRUS (Ogilby, 1836).

This Genus includes the familiar little Ring-tailed Opossums, of which there are nearly thirty recognised species. This large assemblage of forms is usually split up into five Sub-genera, as follows :—

(A.) Ears longer than broad ; tail with a white tip.

(B.) Tail evenly bushy ; naked part short : nasal bones reaching forwards only to about the level of I^3.

Sub-genus 1. *Hemibelideus.*

(B¹.) Tail short-haired terminally ; nasals reaching as far forwards as $I.^1$. (*See* Figure 135.)

Sub-genus 2. *Pseudochirus* (*sens. strict*).

(A¹.) Ears broader than long ; tail usually without a white tip.
(C.) Form robust. Molars 1-3 more than 10·5 mm.
(D.) Bullae moderate size ; tail long.
Sub-genus 3. *Pseudochirops.*
(D¹) Bullae extremely large ; tail short.
Sub-genus 4. *Petrosuedes.*
(C¹.) Form slender. Molars 1-3 less than 10·5 mm.
Sub-genus 5. *Pseudochirulus.*

Sub-Genus 1.—Hemibelideus (Collett, 1884).

There is no South Australian member of this Genus, both forms embraced within it being confined to Queensland.

Sub-Genus 2.—Pseudochirus (Ogilby, 1837) *sens. strict.*

The members of the Sub-genus to which the name *Pseudochirus* is applied in its modern narrowed sense may be termed the typical Ring-ta led Opossums ; and of the half-dozen or more species which inhabit Australia there is only one which occurs in this State. In general, the characters of the Sub-genus are as follows :— Small or medium sized animals, adapted to arboreal life. Fur somewhat woolly. Ears medium in size, hairy behind. Palms and soles naked, with striated pads. Tail with a naked and prehensile termination. The nasal bones projecting in front of the premaxillae. Interorbital region somewhat concave. I^2. slightly bicusped. Dentition I. $\frac{3-3}{2-2}$. C. $\frac{1-1}{0-0}$. P.M. $\frac{3-3}{1-1}$. M. $\frac{4-4}{4-4}$, as a rule, but the number of small intermediate teeth is variable.

South Australian Ring-tailed Opossum.

Pseudochirus laniginosus (Gould, 1858).

This animal has long been known as *Pseudochirus peregrinus* (Boddaert, 1785) ; but, as Oldfield Thomas has recently shown, the animal to which that name rightly belongs came from the Endeavour River, and its description differs widely from that of the present species. The form which inhabits this State differs considerably from that which occurs to the north and east, and is distinguished as *Pseudochirus laniginosus notilis* (Thomas, 1923). The South Australian animal is in general a grey and white opossum, with only a slight admixture of rufous colouration. Fur woolly, soft, and fine, the long hairs of the back measuring about 30 mm. in length. The dorsal surface coloured rather varying shades of grey, the pelage being finely grizzled, each hair being dark at the tip and banded with white for a space of about 2 mm. below the tip. The hair, when parted, shows a smoky grey under-fur. The face is grey, slightly grizzled with rufous ; the rufous colouration being especially marked around the eye. There is a white patch below and behind the eye, separated from the white hairs of the muzzle and chin by an interval of hair of the general body colour. (*See* Figure 131.) The crown of the head and the mesial margins of the ears darker grey than the face, or than the general body colour. Upper lip, chin, throat, ventral surface of the body, and inner surface of the limbs pure white.

Outer side of limbs inclined to be distinctly more rufous than the general colour of the dorsal surface of the body. Manus and pes paler than the dorsal surface of the body, the manus being darker and usually more rufous than the pes. Base of tail, for a space of some 70 mm., covered by hair of the general body colour and texture. Distal to the basal fluffy portion of the tail the hair becomes shorter, more closely adpressed and shining in texture. The basal furry-portion is grizzled, like the general colour of the dorsal surface of the body; immediately following this, for a space of about 90 mm., the smooth-haired portion is almost black, the terminal 160 mm. being pure white. The tail is markedly prehensile, the underside of its tip being naked for a distance of about 105 mm. The ears are large, somewhat rounded in outline, nearly naked on their inner sides, hairy on their outer sides. The hair on the dorsum of the ear is dark, almost black towards its inner side, pure white to its outer and hinder margin. This white patch on the back of the ear is continuous with a long tuft of white silky hair which appears below the lower border of the ear behind the white cheek patch. The processes of the auricle are somewhat complex. The main processus antihelicis is well developed, slightly broader along its attached base than the distance from its base to its free tip; in addition, two accessory processes are developed nearer to the tip of the ear. The tragus and the bursa are well developed. (*See* Figure 132.) All facial vibrissae are well developed and, as a rule, they are wholly black in colour. The mystacial set is arranged in six rows, the longest bristles measuring 65 mm. The genals

FIGURE 131.—Characters of the head of *Pseudochirus laniginosus notilis*. Natural size.

FIGURE 132.—Characters of the ear of *Pseudochirus laniginosus notilis*. One and a half times natural size.

and supraorbitals are also well represented. There is a small tuft of ulnar carpals, and a set of median antebrachials. The calcaneal vibrissae are obvious on the pouch young, but are not conspicuous in the furry adult.

The rhinarium is naked and pink; in texture it is finely granular; it is cleft in its whole length in the middle line, and makes a considerable contribution to the upper lip.

The eye is surrounded by fine dark eyelashes. The pupil is circular, the iris bright golden brown.

The palmar surface of the manus is white, or pale flesh coloured, naked, and granular, with well developed striated pads. The apical pads are finely striated; the interdigital pads are all present,

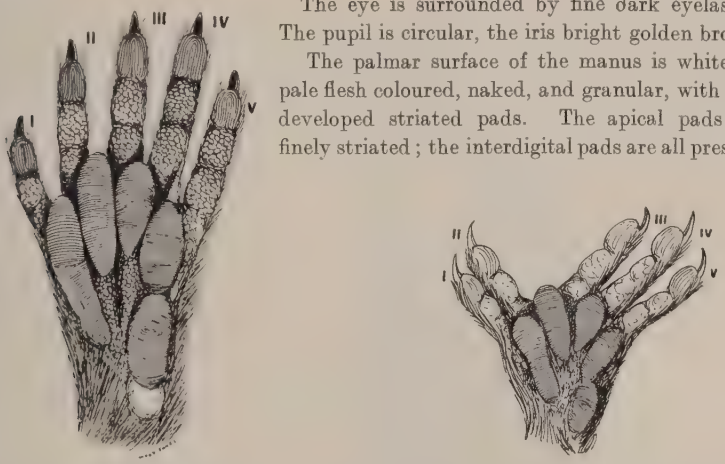

FIGURE 133.—Left manus of *Pseudochirus*. Twice natural size. The inset shows the manner in which the manus is cleft and digits 1 and 2 are opposed to digits 3, 4 and 5 in grasping.

the first interdigital being confluent with the thenar pad. The digital formula is $4 > 3 > 2 > 5 > 1$. (*See* Figure 133.). In grasping, the first and second digits are opposed to the third, fourth, and fifth. The pes has a naked granular sole, with six well developed and striated pads, the first interdigital and the hallucal pads being separate. The apical pads are all striated. The first digit is large, clawless, and opposed to the remaining digits. The digital formula is $4 > 5 > 2 > 3 > 1$. (*See* Figure 134.) The pouch is well developed, the opening forwards. Four nipples are present, but only the posterior pair is fully developed and functional.

The general characters of the skull are shown in Figure 135.

DIMENSIONS.

	All from Mount Lofty, Measured in the flesh.			
	Adult ♂.	Adult ♀.	Adult ♀.	Adult ♀.
Head and body	340	330	380	360
Tail	365	320	320	340
Hind foot	40	40	41	41
Ear	35	37	40	39
White portion of tail	155	150	170	155
Naked portion of tail	110	105	105	100

DIMENSIONS OF SKULL.

	Adult ♀. Mt. Lofty.
Basal length	58
Breadth	35
Nasals, length	25
Palate length	30
Interorbital construction	7

Ring-tailed Opossums are still fairly common in the wooded and cultivated districts, and it is probable that the foot hills of the Mount Lofty Ranges will afford them shelter for many years to come. They do not make their presence so obvious as do the Bushy-tailed Opossums (*Trichosurus*), for they have not in general adopted the latters' habit of living in the roofs of houses. They prefer to live out in the trees, where they either construct a well built drey among the branches, or take possession of a hollow branch which they line with nesting material. Even in captivity they are industrious nest builders, and they invariably fill their sleeping boxes with a great assortment of twigs and dead leaves.

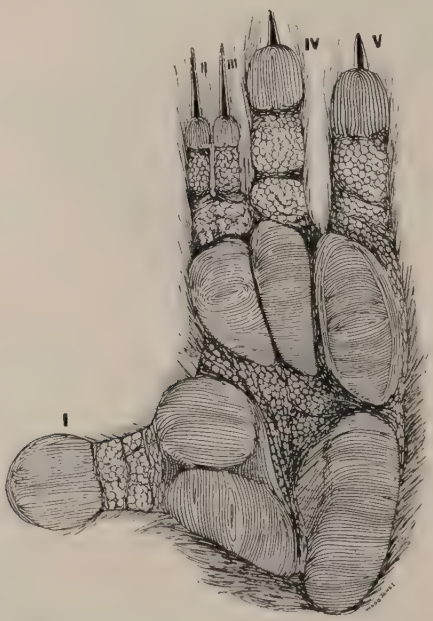

FIGURE 134.—Left pes of *Pseudochirus*. Twice natural size.

Except for the damage that they do in the fruit gardens they are thoroughly inoffensive animals. Though very beautiful and attractive creatures in captivity, it must be admitted that, as pets, they fail somewhat owing

FIGURE 135.—Lateral view of the skull of *Pseudochirus laniginosus notialis*. One and a half times natural size.

to their pronounced stupidity. They learn in time that the person who feeds them regularly, and pays careful attention to their comfort, is not greatly to be feared ; but I doubt if their intelligence carries them much further than this in their relations with those who look after them. They permit themselves to be handled freely enough, and are, to that extent, gentle animals ; but there is very little that is reciprocal in their intimacies with man. They appear to learn not to expect ill treatment, but seem unable to evince any response to good treatment. This may, in part, be due to the fact that their eyes are very definitely adapted to the dark, and that they are, therefore, always at a disadvantage in daylight. But, like many animals with dark-adapted eyes, they become very much more suspicious and less reconciled to restraint at night time. Their expression is at all times of a fixed, staring kind, and in their relations with each other they appear to preserve the same apparent stupidity, and the same vacant stare, as they employ in their dealings with man. If two fall out, one will not permit the other to enter the sleeping box, and the rejected animal will curl up in a ball outside, staying there day and night to its great discomfort. Should it decide to enter the box, and in doing so encounter the tenant in the doorway, the meeting will consist in their regarding each other with a prolonged unaltering stare, and then one or the other will give in, and curl up in a ball again. Although very agile, and capable of extremely graceful movements, the usual procedure, when suddenly encountered, is to remain motionless, like a stuffed animal, gazing straight ahead with a meaningless, fixed stare. When quite sure that its stillness has not deceived the intruder, the animal will slowly start to creep away. When running on the ground, Ring-tailed Opossums can go at a fair speed, but owing to the low carriage of the head and tail, and to the waddling type of gait, they are far from graceful when forced to make their way across open country. When climbing, they evince the universal characteristic of animals which have prehensile tails, for they trust the tail grip and the grasp of the pes far more than they rely on the hold of the hand. They therefore always descend head downwards, and do not hesitate to relinquish the grasp of the manus no matter what the position may be.

They are extremely quarrelsome, and for the greater part of the year the females will not permit the males to come near them ; the introduction of a male into the domain of a female being the certain prelude for a fight. The fighting is never very prolonged, for one or the other soon admits defeat and withdraws. The female appears to be far the more aggressive, the male being, as a rule, glad enough to slink away and avoid further encounter.

The voice is comparatively rarely used, and it consists in a rather musical, almost bird-like, repetative note. This pleasing note is not often uttered, and probably most people hearing it in the open would not suspect that it was produced by a mammal. It differs altogether from the harsh grunt which is employed when fighting. The young animal, when separated from its mother, produces a shrill chirrup, which is very like the note made by bats. The breeding season is in the early months of the year, the young leaving the pouch about the end of April. They breed only once a year, and two young are usually produced at a time. The hairless young are dark-leaden colour, and not pink as are the young of *Trichosurus*. On leaving the pouch, the young animals are almost exactly like their parents,

and they cling to the fur of the mother, gripping their claws into her woolly hair and twining their tails about her body.

By daylight the sense of sight is poor, for the eyes are strongly dark-adapted. Probably by night sight is the principal guiding sense, and undoubtedly it is much assisted by the information imparted by the tactile vibrissae. For an arboreal animal the sense of smell seems to be unusually well developed, for a young animal is able to follow the track along which its mother has passed, and in this it is guided by scent alone.

The Ring-tailed Opossums are not confined to eucalyptus trees, for any type of tree which affords them a sufficient shelter will provide a home for them. Their range does not extend into the Centre, where the box trees lining the creeks afford a home for the Brush-tailed Opossums, and their distribution in the State is probably limited.

Sub-Genus 3.—Pseudochirops (Matschie, 1915).

This division of the Genus contains about a dozen recognised species which are mainly confined to New Guinea, only one member extending the range into Queensland. None is present in South Australia.

Sub-Genus 4.—Petrosuedes (Thomas, 1923).

The Sub-genus was created for the reception of the peculiar Rock Opossum (*Petrosuedes dahli*) of North-West Australia. This species has not been recorded in South Australia.

Sub-Genus 5.—Pseudochirulus (Matschie, 1915).

Some half-dozen species belonging to this subdivision of the Genus are present in New Guinea, but no member extends the range into continental Australia.

Genus 2.—PETAUROIDES (Thomas, 1888).

The Genus contains the fine "Flying Phalangers" of Eastern Australia. These handsome animals, known as Taguan Flying Phalangers or Great Flying Phalangers, occur in Victoria; they were included in the Fauna of South Australia, by F. G. Waterhouse (Harcus's South Australia, 1876, p. 284), but I know of no record of their extension into this State.

It must be remembered that the Genus *Petauroides* constitutes only one of the three groups of Flying Phalangers, of which the other two will be mentioned later. It is a very remarkable fact, which cannot fail to impress the student with the complexities of animal adaptations, that three arboreal forms of syndactylous marsupials should have independently given rise to volant forms. The Taguan Flying Phalangers are undoubtedly volant derivations of more normal arboreal members of the *Phascolarctinae*, and it is to some form such as the Ring-tailed Opossums that we must look for their ancestry. The other Flying Phalangers, to be dealt with later, are equally clearly derived from other and distinct arboreal forms.

Genus 3.—PHASCOLARCTUS (Blainville, 1816).

With the Genus *Phascolarctus* specialisations have proceeded so far in certain directions that most authorities have assigned the rank of a separate Family or Sub-family to its only member. The sole representative of the Genus, the Koala, or Native Bear, exhibits a strange blend of characters, and in certain directions it departs from the type usual among the *Phalangeridae*, and, to a certain extent, it shows such striking likenesses to the Wombats that by many it is regarded as their near ally, and is therefore united with them in one family. That it is an example of extreme specialisation to tree climbing, and to tree clinging, is obvious; and in this specialisation it finds its parallels among the Monodelphia in the Sloths and Slow Loris. From a general survey of the anatomical

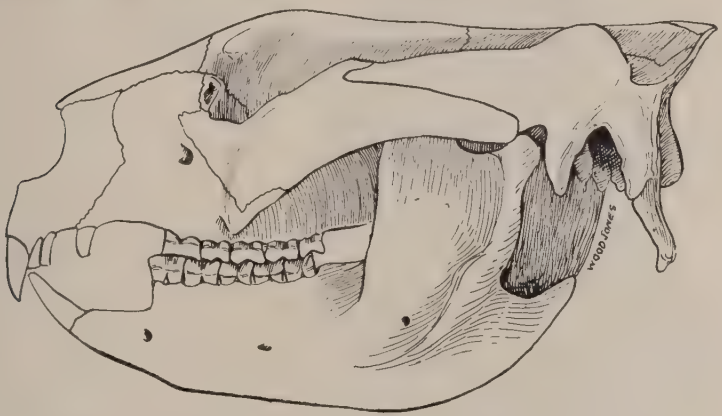

Figure 136.—Skull of *Phascolarctus cinereus*. Two-thirds natural size.

characters of the animal it is most reasonable to assume that it is a phylogenitically senile and over specialised Phalanger, and most nearly related originally to the Ring-tailed Opossums.

The size is large, and, owing to the stout and rather clumsy build of the body and practical absence of the tail, the general appearance is somewhat that of a little bear. The fur is dense and woolly. The ears are large and thickly covered with hair. The tail is reduced to a mere rounded projection. Both manus and pes are furnished with five strongly-clawed digits, the first and second digits of the manus being opposable to the other three. The palms and soles are granular without striated pads. Nipples two in number.

The skull (*see* Figure 136) is of remarkable form, being oblong, and remarkably straight sided. The bullae are peculiarly elongated and flattened from side to side. In respect to the posterior palatine vacuities, and in some other details, a likeness is shown to the skull of the Wombats. The dentition is I. $\frac{3-3}{1-1}$. C. $\frac{1-1}{0-0}$. P. M. $\frac{1-1}{1-1}$. M. $\frac{4}{4-4}$. It is generally agreed that only a single species represents the Genus to-day, but within the wide limits of its range it exhibits such considerable variation that Oldfield Thomas has recently separated the Queensland form as a sub-species to which the name *Phascolarctus cinereus adustus* (Thomas, 1923) has been given.

Koala, Native Bear, or Native Sloth.

PHASCOLARCTUS CINEREUS (Goldfuss, 1819).

This remarkable animal, of which the general figure is familar to everyone, needs but little description for the purpose of identification. (*See* Figure 137.) The dense woolly fur is for the most part dark-grey in colour, though considerable variation in the depth of coat colour is displayed. The hairy ears are fringed with white; and the chin, chest, ventral surface, and inner aspect of the fore limbs are usually pure white. The rump is variably dappled with whitish patches. The inner aspect of the hind limbs, and, in some specimens, the region of the hind end of the body, tawny yellowish. The tail reduced to a mere rounded prominence. The ears are hairy without and within. They are large and rounded in their outline. The processus antihelicis is not well developed: two tragoid projections are present (*See* Figure 138.) The rhinarium is remarkable for its curious backward extension towards the eye, and for the fact that it is thinly clothed with fine downy hairs. The nostrils are slit-like and confluent at the margin of the lip, their immediate edges are naked and shining. (*See* Figure 139.)

FIGURE 137.—General characters of *Phascolarctus cinereus*. Note the way in which the 1st and 2nd digits of the left manus are opposed to the 3rd, 4th, and 5th. About one-fifth natural size.

The pupil of the eye is remarkable in that it is vertical and slit-like; the iris is bright yellow-brown. The eye is small for so large an animal, and has a peculiar, almost comical, staring expression. All sensory vibrissae are poorly developed; the mystacial, supraorbital, and submental sets are alone represented by a few ill defined bristles.

The manus is relatively very large, and has for its digital formula 4 · 3 · 5 · 2 · 1. (*See* Figure 140.) The first and second digits are markedly opposed to the third, fourth, and fifth, so that the hand appears to be cleft into two portions.

The first digit is not in any way specialised. All digits are armed with strong curved claws. Apical pads are present and striated, though the striations are not

FIGURE 138.—External ear of *Phascolarctus*. The two tragoid projections are marked X. X.

very strongly developed. The palm is granular, and the pads are not well defined. In the pes the digital formula is $4 > 3{\cdot}2 > 5 > 1$. (*See* Figure 141.) The syndactylous digits are peculiarly well developed, doubtless in harmony with the depth of the dense fur. The first digit is short and greatly broadened; it possesses no nail. Strong claws are present on all the other digits. The apical pads are present and striated. The sole is naked and granular without differentiated pads.

The pouch is peculiar: the mouth is situated towards its hind end, and its lateral recesses extend far out on to the animal's flank. The nipples are two in number.

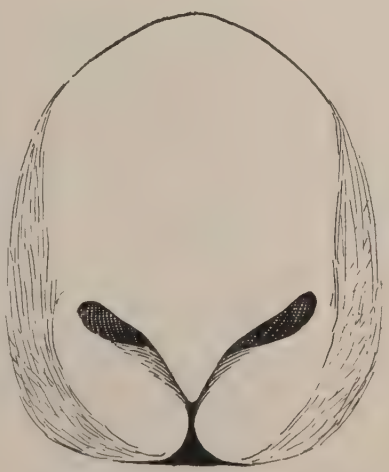

FIGURE 139.—*Phascolarctus cinereus*. Rhinarium viewed directly from the front.

DIMENSIONS.

	Brit. Mus. ♂	Brit. Mus. ♀
Head and body	810	750
Hind foot	96	98
Ear	62	58

DIMENSIONS OF SKULL.

	A. Brit. Mus. ♂	B.	C. Brit. Mus. ♀	D.	E.
Basal length	149	144	128	126	112
Breadth	88	84	75	70	72
Nasals, length	48	45	39	35	24
Palate length	80	69	67	63	60

The habits of the Koala are well known, for the animal is easily observed in a wild state, and it is not uncommonly kept in captivity as a pet. It may be said to spend its whole life clinging to, and feeding upon, the great eucalyptus trees.

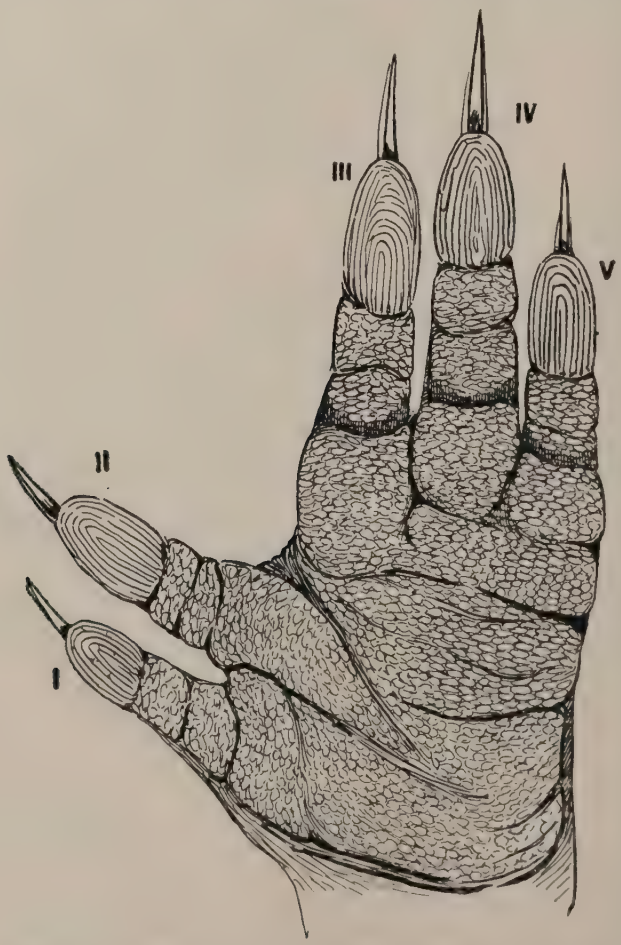

FIGURE 140.— *Phascolarctus cinereus.* Palmar surface of left manus.

In just so much as it is a perfected specialisation to its environment, so it is a slave to its environment. It has adapted itself to the gum tree, and has become dependent upon the gum tree. It must be regarded as an animal which has become phylogenetically senile as the outcome of complete specialisation; an animal which,

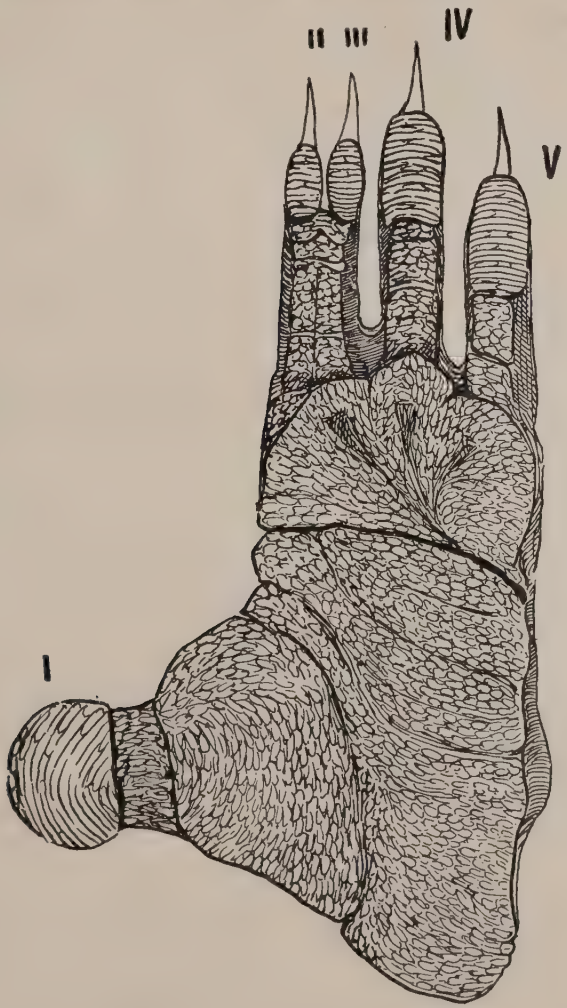

FIGURE 141.—*Phascolarctus cinereus*. Plantar aspect of left pes.

having lost its plasticity, has become dependent upon a definite mode of life in a restricted environment. A Koala driven from its elected environment cannot make itself at home in a new one as can rats, or foxes, or other plastic animals; indeed, it is an old observation that a Koala taken from a gum tree and liberated, will immediately climb the nearest tree and stay there. For this very reason it is

an animal that needs all the protection which legal enactments and popular opinion can afford it; and yet probably no animal has been so ruthlessly slaughtered in order to satisfy the demands of the fur trade. Lucas and Le Souef, in their Animals of Australia, make the remarkable statement that the fur "fortunately is not valued in the market" (p. 92); at the same time noting in the introductory chapter to their work (p. 6) that, in the year 1908, no less than 57,933 Koala pelts passed through the markets of Sydney alone. That this deplorable slaughter still goes on is evidenced by the fact that in the two years 1920 and 1921 Osborn and Anthony have ascertained that the huge total of 205,679 Koalas were killed for the fur market. Since in the fur trade Koala pelts pass under the name of "Wombat," many people assume that the Native Bear has ceased to be persecuted.

The complete extermination of the Native Bear would be a disgrace to Australia, and yet, from its dependence upon a particular diet and a particular mode of life, its tenure of continued existence must always be regarded as precarious. It should be rigidly protected and preserved where it still exists, and every effort should be made to extend its range, and to re-establish it in those areas from which it has already been exterminated.

The animal is wholly inoffensive, and makes a most curiously affectionate, even if rather an unintelligent, pet. When brought up in captivity it becomes strangely dependent upon human society, and dislikes being left alone. A Native Bear which has for long been treated as a pet becomes in the end a very exacting and babyish creature. The food is gum leaves, and the animal is very particular in the choice of the leaves that it eats: when it has ascended a tree to its liking it will eat the tender shoots, and before it changes its tree it will strip it of most of its young leaves. The whole animal smells strongly of eucalyptus, and its excretion of this pungent smelling substance is one of its drawbacks as a pet. In captivity it will take bread and milk, and it is curious that it laps rather than sucks its drink.

Although quite harmless, Koalas are powerfully armed with strongly curved claws, and they can scratch severely. The old males have a tremendous voice, somewhat like the braying of an ass, but this accomplishment appears to be only rarely exercised, the common vocal expression being a hoarse grunt.

A single offspring is produced at a birth, and the curious little creature clings to to the fur of its mother's back for a long while after it has left the shelter of the pouch.

Although a most thoroughly arboreal animal, and one that has been over specialised for arboreal clinging, it can shuffle along on the ground at a good pace: but if a tame one be placed on the floor it will make all speed to climb up the person who stands nearest, and the weight of the sturdily built body and the degree of development of the claws make this demonstration of friendship one that may be embarassing. It is extremely tenacious of life, even when mortally wounded, and horrible cruelties have been committed and recounted by those who have slaughtered them wholesale for the sake of their pelts. Indeed, one may say, on humanitarian grounds, that not only should the slaughter of the Koala for the fur trade be prohibited because the animal is eminently one to protect and not to exterminate, but it should be prohibited because, like the slaying of seals, it is the most brutalising occupation that a human being can undertake.

At one time the Koala was without doubt an inhabitant of South Australia, and many men now living can remember the time when it was by no means uncommon in certain districts of the South-eastern portion of the State. No more than ten years ago Koalas have been killed well within the geographical limits of South Australia. If it inhabits South Australia to-day is rather doubtful, although reliable information would point to the fact that a remnant of the stock may still linger not far from the Victorian border. So far as I know no example of the South Australian race has been examined scientifically, and no specimens seem to have been preserved. Victorian animals were liberated on Flinders Chase, Kangaroo Island, in November, 1923, and it is hoped that they will become established in that faunal sanctuary.

Sub-Family II.—**PHALANGERINAE.**

The members of the Sub-family are small or medium sized Phalangers which do not show the cleft manus in which digits 1 and 2 are opposable to digits 3, 4, and 5. The molar teeth have mound-like (bunodont) cusps.

Division of the Sub-family into Genera :—

(A.) Tail distichous (flattened, and fringed with hair along the sides). Molars $\frac{3-3}{3-3}$.

(B.) With a flying membrane. Face not striped.

Genus 1. *Acrobates*.

(B¹.) Without a flying membrane. Face striped.

Genus 2. *Distoechurus*.

(A¹.) Tail not distichous, but cylindrical and evenly haired. Molars $\frac{4-4}{4-4}$.

(C.) Claws of the manus short, not exceeding the apical pads. Tail evenly short haired terminally.

Genus 3. *Dromicia*.

(C¹.) Claws of manus long, extending beyond the apical pads. Tail not short-haired terminally.

(D.) Tail hairy to end.

(E.) Without a flying membrane.

Genus 4. *Gymnobelideus*.

(E¹.) With a flying membrane.

Genus 5. *Petaurus*.

(D¹.) Tail naked at the end.

(F.) Fourth digit of manus much longer than the others. Last lower premolar lower than molars.

Genus 6. *Dactylopsila*.

(F¹.) Fourth digit of manus not greatly elongated. Last lower premolar as high as the molars..

(G.) Tail naked all round at end.

Genus 7. *Phalanger*.

(G¹.) Tail bushy to end above and at sides, naked below. Genus 8. *Trichosurus*.

Genus 1.—ACROBATES (Desmarest, 1817).

The little animals included in this Genus are known as Pigmy Flying Opossums. One species (*Acrobates pygmaeus*) inhabits continental Australia, and extends through Queensland, New South Wales, and Victoria; on one or two occasions it has been taken in that portion of South-eastern South Australia which appears to be geographically, though not politically, a part of Victoria. The characters of the Genus are that the animals are small, and bear upon their flanks a parachute membrane, the constitution of which is such that a very narrow skin fold is converted into a plane by the development of an even fringe of hairs along its margin. The tail is distichous, consisting of the central axis with a fringe of stiffish hair springing from each side of it. The apical pads of the digits are large, but the claws extend beyond the tips of the digits. Dentition I. $\frac{3-3}{2-2}$. C. $\frac{1-1}{0-0}$. P.M. $\frac{3-3}{3-3}$. M. $\frac{3-3}{3-3}$.

Figure 142.—General dorsal view of *Acrobates pygmaeus*. Natural size.

Pigmy Flying Opossum. Feathertail.

Acrobates pygmaeus (Shaw, 1794).

Form very light and delicate, the animal being one of the smallest of the Didelphia. (*See* Figure 142.) Fur very soft and silky. General colour a rather warm brown on the dorsal surface, pure white below. Face light-brown, a slight admixture of greyish hair is present on the muzzle region; area immediately around the eye dark-brown. Outer surface of limbs brown like the dorsal surface. Manus and pes light rufous brown. The whole of the tail light-brown, somewhat paler below than above. The inner side of the limbs, like the whole of the ventral surface, pure white; the hairs being white to their roots. The hairs of the under side of the parachute fringe white, tending to be smoky-grey at the roots. Hairs of the dorsal side of the parachute fringe brown at the tips, also grey at the roots. Parachute fringe 6 mm. in depth. The tail, which is slightly longer than the head and body, is a most remarkable adaptation of structure to function, the curious flat fringe of hairs that spreads from each side to a total width of 8 mm constituting an additional parachute plane. This flattening of the tail affects even the structure of the tail itself, for the skin on each side of the central axis is produced as a little flattened shelf from which the hairs spring. (*See* Figure 143.) (This curious adaptation is not noticeable in the dried skin.) The ears are

fairly large and oval in outline; when laid forward they reach to about the middle of the eye. The outer surfaces are clothed with hair, which, on the front part of the ear, is of the general brown body colour, but along the hinder margin is white. The inner surface naked, save for tufts of long, white, crenated hairs which spring from all the prominences of the concha. The processus antihelicis is thin and prominent, oval in outline, and it gives rise to a tuft of long white hairs. The rhinarium is naked, flesh coloured, and finely granular in texture. It is deeply cleft in the middle line. The nostrils are lateral. The eye is dark-brown. All vibrissae are extremely well developed, some of the mysticial set reaching the relatively enormous length of 27 mm. The genals are placed exceptionally far back. The ulnar carpal tuft is well marked, but the calcaneal group is not recognisable.

The manus has a naked granular palm. The striated apical pads enormous and much enlarged laterally, with a tendency to be cleft in the mid line at their free extremities. Five typical palmar pads well developed and finely striated. Claws extending to the ends of the apical pads. Digital formula $4 > 3 > 5 > 2 > 1$. Pes with naked granular soles and the usual striated plantar pads. The striated apical pads of digits 1, 4, and 5 heart-shaped, the base of the heart being directed towards the free tip of the digits. Apical pads of the syndactylous digits simple. Digital formula $4 > 5 > 2{\cdot}3 > 1$. First digit well developed, opposable to the rest of the digits, and clawless. Claws on all other digits well developed and extending beyond the ends of the pads.

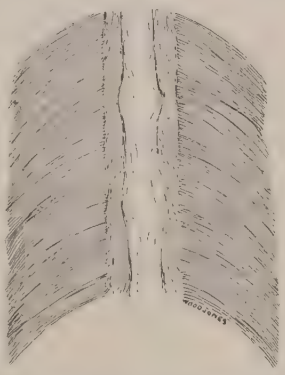

FIGURE 143.—*Acrobates pygmaeus*. Enlarged drawing of a portion of the tail to show the lateral skin flanges and the lateral hair fringes.

The pouch has well marked lateral and anterior extensions, and is lined with yellow hair. Nipples four in number.

DIMENSIONS.

	Skin. ♀ N.S.W.	♀ S.A.	♀ Brit. Mus. Queensland.	♂ Brit. Mus.
Head and body	65	67	64	67
Tail	70	75	69	78
Hind foot	10	11	13	13·6
Ear	8	9	9	9

DIMENSIONS OF SKULL.

	Brit. Mus.
Basal length	18·3
Breadth	13·3
Nasals, length	7·1
Palate length	11

This beautiful little animal is not uncommon in the eastern States, but owing to its small size and nocturnal habits is but seldom observed. It is freely caught by the domestic cat. I have seen only one living example, in Victoria; but as the species extends into this State it is much to be hoped that South Australian naturalists will make it a special object of study with a view to determining its exact distribution. Of its habits little or nothing has been recorded. By Lucas and Le Souef it is said to be insectivorous, but no evidence is given in support of this assertion, and possibly it is merely a deduction from the characters of the teeth. Probably it could be kept and bred in confinement with but little difficulty, and in that way the more intimate details of its life history could be studied.

Genus 2.—DISTOECHURUS (Peters, 1874).

The only member of this Genus—the so-called Pen-tailed Phalanger—is an inhabitant of New Guinea.

Genus 3.—DROMICIA (Gray, 1841).

The members of this Genus are the beautiful little animals rather aptly named Dormouse Opossums. They are small animals with large, thin, almost naked ears. There is no parachute membrane. The tail is cylindrical and prehensile. The claws of the manus are short. Skull short and broad, bullae very large. Dentition I. $\frac{3-3}{2-2}$. C. $\frac{1-1}{0-0}$. P.M. $\frac{3-3}{2 \text{ or } 3}$. M. $\frac{3 \text{ or } 4}{3 \text{ or } 4}$. The Genus, which ranges from New Guinea to Tasmania and Western Australia, comprises four species of which one is a member of the fauna of South Australia.

Elegant Dormouse Opossum.

Dromicia concinna (Gould, 1841).

In general form like a small and elegantly built dormouse, with strikingly human, or simian, manus, and a long slender prehensile tail. (*See* Figure 144.)

The general colour warm red-brown above and white below. The fur is soft and close. The muzzle is light rusty-brown, the colour darkening slightly around the eye: the crown of the head, the whole of the dorsal region of the body, and the outer side of the limbs clothed with fine hairs 5 mm. in length, bright red-brown at the tips, and smoky-grey at the base. The muzzle below the eye, the chin, throat, whole of ventral surface of the body, and inner side of the limbs are white; the hairs being white to their roots on the ventral surface, but greyish at the roots towards the side of the body. The line of demarcation between the red-brown back and the

Figure 144.—*Dromicia concinna*. Adult female from the Mount Lofty Ranges. Natural size.

white ventral surface is sharp. The tail is about as long as the head and body, slender, gently tapering, and prehensile. The basal sixth is clothed with soft body hair on its dorsal, and to a lesser extent on its ventral surface. The remaining portion clothed with scales and naked, save for short sparse hairs which spring from the spaces between the scale rows. The scales are small, and typically some thirty-five rows are present in 1 cm. of the length of the tail. The ears are large and membranous. When laid forward they completely cover the eye. In outline they are oval, but in life they are usually carried more or less folded. They are nearly naked, only sparse short hairs being present on either surface. There is a large leaf-like processus antihelicis and a well developed bursa. The rhinarium

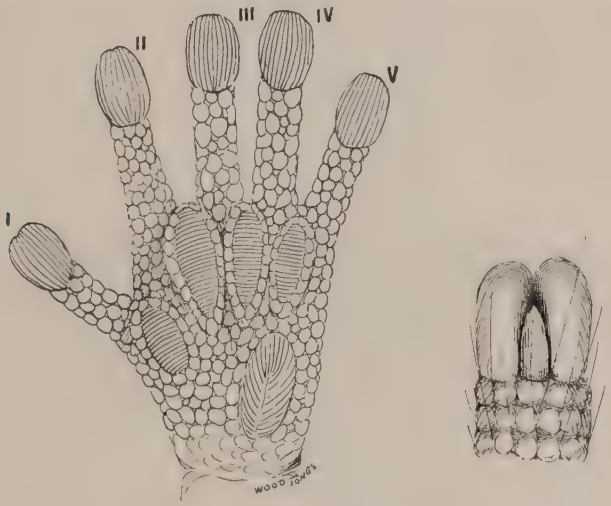

FIGURE 145.—*Dromicia concinna*. Palmar surface of left manus, ten times natural size; and enlarged view of the dorsal surface of the tip of the fourth digit.

is naked, flesh-coloured, and finely tessellated in texture; it is cleft in its entire extent. The nostrils are lateral and crescentic. The eye is black, and the long black eyelashes are well developed. Sensory vibrissae are well marked. The bristles of the mysticial set attain a length of 22 mm., and their tips reach back well behind the free point of the ear. All the typical facial groups are present, the bristles being brown in colour, with the exception of the genal and interramal sets, which are white. Upon the fore limb the ulnar carpal group is represented by three white vibrissae 5 mm. in length, and the medial antebrachial bristle is almost twice that length. A rather inconspicuous calcaneal vibrissa is also present. The manus and pes are white. The palm of the manus is granular, with five well developed and finely striated pads. Apical pads are well developed, extending well beyond the tips of the claws, and striated. The digital formula is $4 > 3 > 2 > 5 > 1$. (*See* Figure 145.) The claws on all digits are small, that on the first digit being a flat nail rather than a claw. The sole of the pes is granular, with five well developed

striated pads. The first digit is highly specialised, standing at right angles to the axis of the rest of the digits, and it is clawless. Apical pads are large and striated. They are distinctly bifid, showing a structure convergently somewhat similar to the pads of certain of the Geckos. The digital formula is $4 > 5 > 2.3 > 1$. (*See* Figure 146.) The claws of the syndactylous digits are well developed and project some distance beyond the pads. The claws of the fourth and fifth digits do not quite reach to the extremities of their pads.

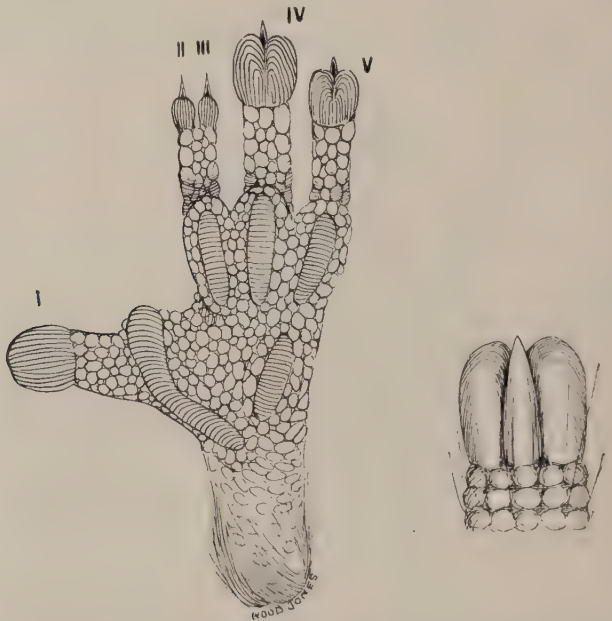

FIGURE 146.—*Dromicia concinna*. Plantar surface of left pes, eight times natural size: and enlarged view of the dorsal surface of the tip of the fourth digit.

The pouch is the shape of a conventionalised heart, the opening being at the forward end, and two lateral extensions passing forward to the side of the body in front of the legs. The nipples are six in number. The skull is broad and rounded. The bullae are very large and nearly transparent. The posterior part of the palate is perforated from the front of the first molar tooth to its hinder end.

DIMENSIONS.

	Brit. Mus. ♀ S.A.	Mt. Lofty. ♀	Kangaroo Island. ♀	Kangaroo Island. ♂
Head and body	80	90	78	77
Tail	89	83	70	82
Hind foot	12·2	9	10	10
Ear	12	13	13	13

DIMENSIONS OF SKULL.

	Brit. Mus.
Basal length	19·6
Greatest breadth	14
Nasals, length	7·5
Palate length	10·5

This beautiful little animal is apparently not very uncommon in the wooded districts of the southern portion of the State, and it is gratifying to know that it occurs on Kangaroo Island, where it enjoys the sanctuary afforded by Flinders Chase. In Kangaroo Island, as in Western Australia, it lives mostly in the tops of "Black boys" (*Xanthorrhoea*), but upon the mainland it is usually found in holes in trees, or beneath loose pieces of bark. In the Mount Lofty Ranges it occurs in the orchards. A nocturnal animal, as small as the Dormouse Opossum, usually escapes observation unless its sleeping place is accidentally discovered by day. The greatest threat to its continued existence is the presence of domestic and feral cats which, though they have assisted as collectors of many of the small marsupials, are certainly one of the most destructive agents now at work. Mr. Glauert, of the Western Australian Museum, informs me that, near Bunbury, a cat has brought over thirty specimens of *D. concinna* into the house in a few months.

The little creature makes a most attractive pet. The food is held in the very mobile hands as is the case with its larger relatives, and it thrives well on soft fruit, cakes, rose leaves, etc., in captivity. It drinks milk freely, and has a peculiar weakness for jam and for honey. It is extremely gentle, and soon becomes accustomed to handling.

It probably breeds more than once in the year, for young have been found in the pouch in January, July, and September. The number of young varies from one to six, five appearing to be about the average litter. The nest is well constructed, and is usually built behind a loose piece of bark, or in a hole in a dead branch of a tree.

Genus 4.—GYMNOBELIDEUS (McCoy, 1867).

The single species, *G. leadbeateri*, which constitutes this Genus was discovered in the scrub on the banks of the Bass River, in Victoria. It has never been reported from any other place, and since the time of its original discovery by Professor McCoy it seems to have disappeared entirely.

Genus 5.—PETAURUS (Shaw, 1791).

Four very beautiful Flying Opossums are included in this Genus. They are all small or medium sized animals, with strikingly soft and silky fur. The ears are oval, fairly large, and nearly naked. There is a well developed parachute membrane which starts upon the outer border of the fifth digit of the manus, runs along the outer side of the forearm and arm to the sides of the body, and passes down the leg to fade away upon the ankle at the base of the first pedal digit. The fifth digit of the manus, which carries the parachute membrane, is unusually well developed.

Claws are strong and sharp. The tail is long and hairy, the hair being disposed evenly all round the tail and ending as a terminal brush.

The skull is short and broad, and shows marked inflation of the bone of its hinder end. Dentition I. $\frac{3-3}{2-2}$. C. $\frac{1-1}{0-0}$. P.M. $\frac{3}{3}$ $\frac{3}{3}$. M. $\frac{4-4}{4-4}$. Two of the species inhabit the high coastal districts of Queensland, New South Wales, and Victoria: one is confined to New Guinea and some of the islands: and one probably extends into South Australia.

Lesser Flying Opossum. Sugar Opossum.

PETAURUS BREVICEPS (Waterhouse, 1838).

Size small. Fur wonderfully soft and silky. General colour delicate grey with a soft brownish tinge. The face pale-grey. Upon the middle line of the muzzle a darker brownish dorsal stripe commences: upon the crown of the head this darker area broadens out from side to side to make a dark patch upon the middle line of the forehead. It contracts again upon the back of the neck and remains distinct, as a rule, along the whole of the dorsal surface of the body, nearly to the base of the tail. In addition to the dark dorsal stripe, the area around the eyes is also somewhat darkened, and a patch of brown hairs is present above and below the entrance to the ear. The hairs of the dorsal surface of the body are some 8 mm. long, very fine, pale at their tips, and smoky towards their bases. The hair of the upper surface of the parachute is rather rich brown in colour, darker than the general body tone, the hairs only having a minute portion of their tips pale. An even fringe of white hairs constitutes the free edge of the parachute. Outer surface of limbs is the same colour as the general body fur, or somewhat paler. Manus and pes paler, almost white. Inner aspect of limbs and whole of ventral surface white, slightly tinged with yellow or grey. Tail longer than the head and body: uniformly hairy, bushy towards the base where the hairs measure 20 mm. In colour the tail is pale soft grey in its basal portion, becoming darker and more brown for the last 60 mm., the tip itself being almost white.

The ears are large, and when laid forward they cover the eye. In outline they are oval, the posterior border, however, being less evenly convex than the anterior: they are membranous and almost naked both within and without. A well developed, flattened, processus antihelicis is present, the free edge of which is evenly rounded. The rhinarium is naked and finely granular, cleft in the whole of its extent, and forming a wide contribution to the upper lip. The nostrils are lateral and crescentric. The eye is dark-brown. Fine black eyelashes fringe both eyelids.

All the typical facial vibrissae are present, members of the mystacial set measuring 30 mm.; all are dark at the base and pale towards the tip. The ulnar carpal set is represented by three or four white bristles 10 mm. in length. The calcaneal set of vibrissae is present: two or three white bristles spring from the inner side of the ankle where the parachute membrane fades out towards the foot.

The manus shows a naked granular palm with five well developed, finely striated, pads. Apical pads are well developed and striated. The claws are long and sharp. The digital formula is $4 > 5 > 3 > 2 > 1$.

The sole of the pes is naked, save where some hair trespasses from the margins of the foot in front of the heel. There are five well developed and striated pads.

Apical pads are present and striated, claws long and curved. The digital formula is $4 > 5 > 2.3 > 1$. The first digit is well developed, opposed to the rest of the digits, and clawless. The nipples are four in number. The pouch is distinctly bilocular when containing the young, and consists of two lateral pouches extending far on to the flanks of the animal; the opening is near to its anterior extremity in the undilated condition.

DIMENSIONS.

	Skin, possibly S.A.	Victoria. ♀	Brit. Mus. Tasmania. ♂
Head and body	131	166	172
Tail	175	175	190
Hind foot	17	25	29
Ear	17	21	28

DIMENSIONS OF SKULL.

	Brit. Mus. ♀
Basal length	37
Breadth	28
Nasals, length	14·2
Palate length	21·7

Although this beautiful animal occurs in Victoria, I have no definite record of its ever having been taken in South Australia. Among the specimens in the collection of the late Mr. A. H. C. Zietz is a skin probably taken in this State, but the South Australian Museum possesses no examples known to be South Australian in origin. It thrives well in captivity and has several times bred in the London Zoological Gardens. The animal's description is included here in the hope that it will be found to be an inhabitant of the South-eastern portion of the State, and that wherever it happens to be met it will receive the protection and the study which it merits.

Genus 6.—DACTYLOPSILA (Grey, 1859).

Four very beautiful Striped Opossums which, with the exception of one Queensland form, are confined to New Guinea and the neighbouring islands, are included in the genus. One curious New Guinea species has more recently been separated into a separate Genus—*Dactylonax* (Thomas, 1910).

Genus 7.—PHALANGER (Storr, 1780).

This large Genus contains some fourteen species, and a great number of subspecies, of woolly-haired opossum-like Cuscuses. They occupy the Austro-Malayan sub-region from Celebes to North Queensland. They have the distinction of being among the most gaily coloured of the marsupials, and they display a wonderful range of individual variation in their colour and markings. None extends the range of the Genus to anywhere near the borders of this State.

Genus 8.—TRICHOSURUS (Lesson, 1828).

The animals included in this Genus are the typical Australian Opossums or Phalangers from which the Opossum fur of the world's markets is obtained. In size the animals are large. The fur is thick, close, and woolly. Ears medium or short, more or less hairy behind. No parachute membrane is present. The claws are large, curved, and strong. The palms naked and granular, with indistinctly striated pads. Soles naked in the fore part, but thickly hairy under the heels. Tail thick and evenly bushy, not tapering, the terminal portion naked below and prehensile.

Skull stoutly built, flattened from above downwards. Bullae low and but little inflated. Dentition I. $\frac{3-3}{2-2}$. C. $\frac{1}{0}\frac{1}{0}$. P.M. $\frac{2-2}{1-1}$. M. $\frac{4-4}{4-4}$. Two very variable species are contained in the Genus, and one of these inhabits South Australia.

Common or Bushy-tailed Opossum.

Trichosurus vulpecula (Kerr, 1792).

This, the commonest and most familiar South Australian marsupial, needs but little description for its recognition. (*See* Figure 147.) Nevertheless it is such a variable animal that it is necessary to describe the typical form so that varieties may be distinguished from it. The fur is thick and woolly. The general colour is

Figure 147.—*Trichosurus vulpecula*. Adult example of the typical form. One-fifth natural size.

grizzled grey. The hairs of the back are grey at the base and black at the tip, most of them having an intermediate zone of white. The individual hairs average about 22 mm. in length, and the hair shaft is usually bent at the tip, this bending of the hair producing the woolly texture of the coat. Many of the longer black-tipped hairs, at the mid line of the back, and the hinder part of the body, are perfectly

straight, and produce a more even shiny appearance in the fur of these regions. At the sides of the body the white-tipped hairs begin to predominate. The face is pale-grey, with a darker area round the eye and upon the sides of the muzzle. The whole of the dorsal surface of the body and the outer side of the limbs is uniform grizzled grey. The chin is dark. The ventral surface of the throat and body and the inner side of the limbs are dirty white, there being usually a slight yellowish-red tinge in the colour. This yellowish colour is accentuated on the chest in the males, and around the pouch in the females. The hairs of the ventral surface are grey at the bases and dirty white at the tips. The dorsal surface of manus and pes pale grey.

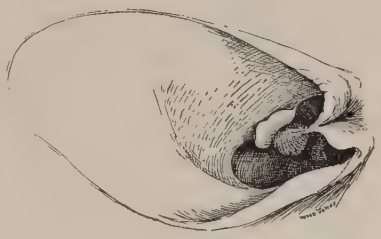

FIGURE 148.—*Trichosurus vulpecula*. Right ear. Natural size.

The tail is thick and bushy and, as a rule, about half its length is clothed with grey hair and half with black on the dorsal surface, and about one-third grey and two-thirds black upon the ventral surface. The change from the basal grey to the terminal black portion is fairly sudden. The terminal portion of the ventral surface of the tail is naked, and here the skin is finely granular, very much like the skin of the palm and sole.

The ears are long and evenly pointed at their tips. The outer side is clothed with hair basally, but the tip is nearly naked. (*See* Figure 148.) The hair at the base shows a variably sized white patch at the hinder margin. Within, the ear is nearly naked. The processis antihelicis is well marked, and a secondary process is present deeper in the proximal part of the concha. During repose the ears are carried folded.

The rhinarium is naked and pink in colour. It is wedge shaped and cleft in the mid line. In texture it is finely granulated. The nostrils are cleft and are lateral in position.

The iris of the eye is dark-brown. The eyelids are dark, and fine black eyelashes are present on both lids.

All vibrissae are well developed. The mysticial bristles are black, and measure upwards of 80 mm. in length. All the typical facial sets are present. On the fore

FIGURE 149. *Trichosurus vulpecula*. Left manus. Twice natural size.

limb the ulnar carpal, medial antebrachial, and anconeal sets are conspicuous. On the hind limb two calcaneal vibrissae are present. The manus has a naked palm, the whole surface of which is granular, the granules being elongated. Apical pads and five palmar pads are present, the thenar pad being fused with the first interdigital. The striations on these pads, quite unlike those present in *Pseudochirus* are made, not by sculptured lines, but by a linear arrangement of the elongated granules. (*See* Figure 149.) The digital formula is $3 > 4 > 2 > 5 > 1$, or $3 = 4 > 2 > 5 > 1$. The claws are strong and curved.

FIGURE 150.—*Trichosurus vulpecula*. Left pes. Twice natural size.

The pes is hairy under the heel. The condition of the sole is similar to that of the palm, but the striate arrangement of the granules on the pads is better marked. The pads are well developed. The apical pads are well developed and are truly striated. The digital formula is $4 > 5 > 2 \cdot 3 > 1$. The syndactylous digits bear elongated claws. The first digit is well developed, opposed to the rest of the digits, and bears no nail upon its flattened extremity. (*See* Figure 150.) The pouch is

well developed, the opening being directed forwards. The nipples are two in number.

The DIMENSIONS of the typical variety, as it occurs round Adelaide, may be taken as follows :—

Head and body	455
Tail	300
Hind foot	55
Ear	42

and the DIMENSIONS of skull as—

Basal length	70
Breadth	48
Nasals, length	30
Palate, length	40

(See Figures 151 and 152.)

In South Australia there are two well marked geographical races which differ considerably from the type. The first of these races inhabits the creeks of the Centre, living in the hollow Box trees (*Eucalyptus microtheca*) which invariably mark the line of the larger creeks and waterholes. Though universally distributed

FIGURE 151.—*Trichosurus vulpecula*. Lateral view of the skull. Natural size.

along the Box creeks, it is nowhere very abundant, as it is eagerly sought out and eaten by the natives. It is typically a small form of light blue-grey colour. There is considerably less contrast in the colour of the dorsal and ventral surfaces than is present in the typical form. Little or no yellowish colouration is present on the ventral surface. The fur is close, smooth, and rather short. The black terminal portion of the tail is considerably shorter than the grey basal portion.

DIMENSIONS.

	Specimens from Longs Creek, Lake Phillipson.	
	♂	♀
Head and body	400	440
Tail	250	255
Hind foot	37	40
Ear	41	42

DIMENSIONS OF SKULL.

Basal length	64
Breadth	46
Nasals, length	26
Palate length	36

FIGURE 152.—*Trichosurus vulpecula.* Dorsal view of skull. Natural size.

The second geographical race is that inhabiting Kangaroo Island. This form lives in bush country rather than in hollow gum trees, and is distinguished by its large size, dense long fur, and tawny colouration. The dorsal surface is tawny grey. The ventral surface yellow or rusty. The white patch at the base of the ears is also yellow. The tail is almost wholly black. To a large extent it is a terrestrial animal, and is always taken in snares set in the runways among the undergrowth which are common to it and to the Wallabies.

DIMENSIONS.

	♂
Head and body	554
Tail	345
Hind foot	60
Ear	40

DIMENSIONS OF SKULL.

Basal length	83
Breadth	58
Nasals, length	36
Palate length	47

Besides these two geographical races, a very distinct melanistic variety occurs (more commonly in animals from the western districts) among the ordinary grey forms; a melanistic young being the offspring of ordinary grey parents. In this variety the fur is particularly smooth and silky. The whole of the dorsal surface is black, but the upper lip, and the patch on the back of the ear are white. The tail is black at its base and white at the tip. The manus and pes, inner side of the limbs, and ventral surface grey. The fine glossy fur and the boldly contrasted black and white colouration make this variety a particularly handsome animal.

The common Opossum may be said to be the only marsupial which is successfully adapting itself to modern conditions. The advance of human enterprise, and the closer settlement of the land have driven most of the marsupials into more and more inaccessible retreats, or have signed their death warrant. But the Bushy-tailed Opossum has become adapted to small holdings, to suburbs, and even to town life. It is as well established in Government House, Adelaide, as it is in the remote box creeks of the Centre or the dense scrubs of Kangaroo Island. It certainly holds the distinction of being the most plastic and adaptable of all its phylum and, for this reason, it is the only marsupial which may be justly described as common or abundant. Wherever sufficient native timber has been permitted to remain, so as to afford a shelter, there Opossums will be found. Moreover, the animal has adapted itself to become independent of the large eucalypti in the holes of which it has its natural home. It has learned that the space under the roof of the usual type of suburban bungalow affords an excellent shelter, and in such situations it freely takes up its residence. In this enterprise Opossums have earned the ill will of the suburban householder, as their activities are nocturnal and noisy.

They are also in ill repute, since disfiguring stains on ceilings often mark the site of their residence above, and contamination of gutters is an important thing in a place where water collected from the roof is of the utmost value. Moreover, the fondness of Opossums for rose buds, and for the fresh young shoots of vines and fruit trees renders them unpopular with the suburban gardener. Practically every man's hand is against them, and yet they survive in a surprising way right up to the limits of the town.

This adaptability is shown also in the wide range of its habitat throughout the State, and throughout Australia. Although it is a thoroughly specialised arboreal animal, it will thrive in treeless areas, and make its home in rabbit warrens as readily as in the topmost branches of giant eucalypti. This habit of living in rabbit warrens has given rise to one of the most ridiculous of Australian pseudodoxia epidemica, which argues that, since they inhabit the same warrens, Opossums and rabbits interbreed. In Kangaroo Island the Opossums live in dense low bush, and they are invariably captured in snares set on the ground in runways used equally by them and by the Wallabies. In the Centre they mostly inhabit the hollow branches and trunks of the box trees which line the sides of the creeks, and here they lie up secure from the Dingoes which will scratch all the bark from the butt of a large tree in their endeavours to bite and scratch out an Opossum safely concealed within. Although the animal shows so much resource, and so much adaptability, it must be owned that an intimate acquaintance with it produces the impression that an inoffensive and stupid simplicity is the keynote of its psychology. It is probably this simplicity which renders all Opossums more or less tame, for there is very little difference in the degree of docility between a fresh caught adult and an animal which has been born and bred in captivity. A wild male has been in the habit of paying evening visits to my captive specimens, fearlessly coming into the outhouse in which their cages are placed. This visitor would permit me to approach and stroke it, but would not allow itself to be grasped or picked up. Freshly caught animals show practically no resentment of captivity, and when placed in a temporary cage are very reluctant to leave it for a larger and more comfortable one.

When handled, even when chased and captured, they, like most marsupials, remain silent: they will bite and scratch, and defend themselves stoutly, but as a rule they utter no cry. But though they are thus voiceless when molested by man, they are extremely noisy in their own domestic quarrels. The ordinary sound expressive of resentment, and a prelude to all encounters, is a long drawn inspiratory hiss. This hiss may die down as a harsh grunt, but when continued becomes increasingly high in pitch and may be modulated into a harsh cry, which rises to a raucous screech when the animals are fighting. During the breeding season, when fights are most common and the animals are most vocal, the male produces a curious sound like a sharp licking of the lips and a click of the tongue. So far, I have not heard a female produce this sound. The cry of the young, when removed from the mother, is extremely loud and quite peculiar, and can be described best by saying that it is so like the voice of the common South Australian tree frog that it is almost impossible to distinguish it from the frog's voice.

In fighting among themselves the Opossums use the claws of the manus far more than the teeth, and although they often inflict scratches on each other and remove quantities of hair, even the noisiest encounters usually result in no great damage to the opponents.

Although the common Opossum has been spoken of as an abundant and an adaptable animal, it must not be imagined that it is one that stands in no need of legislative protection. Any creature which has a pelt of commercial value must needs be protected by legal enactments to prevent its utter extermination. The Australian fur trade has the distinction that it is utterly destructive, the animals whose pelts are marketed are not bred or artificially protected in captivity, they are wild animals slaughtered for their pelts. The most valuable furs in the world's markets—those of certain of the foxes -are derived from animals bred in captivity. This fur trade is a conservative one: the race is kept alive by man's agency in order to supply fashion's demands. But the Australian market is supplied by the slaughter of wild animals—it is a destructive trade, and takes no regard for the conservation of the fur-bearing animal. Legislative enactments for the protection of Australia's fur-bearing animals are therefore absolutely essential. In 1920 the Opossums of South Australia were removed from the protected list from June to September, and in that interval over 100,000 Opossums were killed for the fur trade. Between one and two million pelts of Australian Opossums are marketed every year. In the fur trade the skins of *Trichosurus* pass not only as Opossum, but as "Skunk" (when sheared and dyed) and as "Beaver" as well as "Adelaide Chinchilla."

The breeding season is in June. In this State there is no doubt that the animal breeds normally only once, though it is commonly asserted to breed twice, in the year. It is to be noted that the breeding season is the legalised "open" season in those places in which an open season is declared. That an "open" season should coincide with the breeding season is an anomaly in protective legislation which probably has no parallel in attempts at regulating the slaughter of fur-bearing animals. The animals begin to breed in the year following that in which they are born. Before the young is born the female constantly examines and licks out her pouch, and when the embryo is within it is the object of her constant attention. September 20th is the average date on which the young leave the pouch in Adelaide, and the young animal is a curious creature with a dark-brown dorsal and a bright

yellow tan ventral surface. The young animal becomes independent of its mother during November. During December it gains its grey woolly coat, and by the end of January it is practically full grown. It is usually said that four nipples are present in the female *Trichosurus*. It is well known that the number of nipples is subject to considerable variation in several Australian marsupials; no specimen of *Trichosurus* that I have so far examined has had more than two. It is also often said that two young are produced at a time. I have handled a very large number of embryos and so far have not met with a case in which more than one was present.

Sub-Family III.—TARSIPEDINAE.

The Sub-family contains but a single Genus and species, *Tarsipes spenserae* (Gray. 1842). This beautiful little animal is one of the most specialised marsupials, The extensile tongue and degenerate cheek teeth are obviously modifications begot by the demands of a specialisation of diet. *Tarsipes* appears to be a mammalian nectar-sucker, and the long tongue has undergone its great specialisation in order to obtain nectar by its insertion into flowers, after the fashion common among birds and insects. It is also said that it will eat the soft parts of insects, and feed in captivity by thrusting its long tongue into "sopped bread made very sweet with sugar" (Gilbert). It is a rare animal, most usually seen after its destruction by a cat, and it is confined to Western Australia.

Family II.—MACROPODIDAE.

As we have previously noted (p. 172) the *Macropodidae* constitutes the second great division of the *Syndactyla diprotodontia*, and contains the assemblage of the Kangaroos, Wallabies, and the smaller animals, which, exhibiting the same general type of structure, are known as Rat Kangaroos. In all these animals the hind limbs are characteristically long, the fore limbs being, by comparison, extremely under-developed. The *Macropodidae* are typically saltatory animals, and, but for the curious exception of the Tree Wallabies, are terrestrial. The pouch is well developed ; its opening is at the front, and the nipples are four in number. There are five digits on the manus, but the pes lacks the first digit in all members of the Family except the very aberrant "musk rat" (*Hypsiprymnodon*) of Queensland. A very large number of species is contained in the Family, and the grouping of all the forms into Sub-families and Genera is a matter of some difficulty. Unfortunately, many members of the Family have become extinct in recent years, and descriptions cannot be written from living animals or even from preserved specimens. In these cases the descriptions are taken from previously published accounts, and it is of some importance to discriminate between accounts written from recent animals and those founded on the examination of long preserved skins, for the colours of all members of the Family fade in a remarkable manner when long exposed to light, and in some cases alter very soon after death.

It is obvious that *Hypsiprymnodon* needs separation from the rest of the *Macropodidae*, and this animal, which shows some very well defined linkages with the *Phalangeridae*, is placed by itself in a Sub-family of its own. The remaining members of the Family may be separated into two fairly clearly defined groups, the one containing the Rat Kangaroos—Sub-family *Potoroinae*, and the other comprising the Wallabies and Kangaroos—Sub-family *Macropodinae*.

Of these three Sub-families the *Macropodinae* are obviously the most specialised, and the *Hypsiprymnodontinae* most primitive ; the *Potoroinae* being almost certainly derived by descent from the latter group, but not certainly ancestral to the *Macropodinae*.

The sub-division of the Family is effected upon the following structural basis :—

(A.) First pedal digit present. Tail naked and scaly.
Sub-family 1. *Hypsiprymnodontinae*.

(A¹.) First pedal digit absent. Tail hairy.

(B.) Size small. Ears small and rounded. Claws of manus very large. Canine teeth present.
Sub-family 2. *Potoroinae*.

(B¹.) Size usually large Ears large and pointed. Claws of manus not very large. Canine teeth usually absent.
Sub-family 3. *Macropodinae*.

Sub-Family I.—HYPSIPRYMNODONTINAE.

This Sub-family contains only a single species, the curious animal discovered by Dr. E. P. Ramsay in 1874, and described under the name of *Hypsiprymnodon moschatus*.

It inhabits the dense damp scrub which fringes the banks of some of the Queensland rivers. It is commonly known as the " musk rat," and is an animal which is very rarely met with even in the comparatively restricted area of its natural habitat.

Sub-Family II.—POTOROINAE.

The members of this group are small kangaroo-like animals known as Jerboa Kangaroos, Rat Kangaroos, or sometimes, and less correctly, as Kangaroo Rats. The claws of the manus are very large, those of the median digits being disproportionately long when comparison is made with the lateral digits. The tail is long and hairy. The ears are small and rounded.

Canine teeth are present, and the upper central incisors are far larger and longer than the other upper incisor teeth. The *Potoroinae* is perhaps the most difficult group of the Australian Didelphia to deal with from a systematic point of view. It is also a group which, alas, cannot be much further elucidated by the proper study of any sufficient series of preserved specimens in Australia. The amount of preserved material in our Museums is totally inadequate for a comprehensive survey on modern lines ; and several species have been completely exterminated without any proper study having been made of them either alive or dead. The Sub-family is conveniently split up into Genera as follows :—

(A.) Upper premolar teeth marked by six or more deep grooves.

(B.) Palate nearly complete. Bullae but little inflated. Rhinarium partly hairy. Genus 1. *Aepyprymnus*.

(B^1.) Palate with large vacuities. Bullae markedly inflated. Rhinarium naked. Genus 2. *Bettongia*.

(A^1.) Upper premolar teeth marked by less than six shallow grooves.

(C.) Hind foot longer than the head. Canine teeth minute. Genus 3. *Caloprymnus*.

(C^1.) Hind foot shorter than the head. Canine teeth well developed. Genus 4. *Potorous*.

Genus 1.—AEPYPRYMNUS (Garrod, 1875).

The only animal contained in this Genus is the largest of the Rat Kangaroos, and is confined to New South Wales.

Genus 2.—BETTONGIA (Gray, 1837).

Various names have been given to the animals comprised in this group ; they have been termed Bettongs, Jerboa Kangaroos, Prehensile-tailed Rat Kangaroos, or simply Rat Kangaroos or Kangaroo Rats by various writers. Certain of them have had the local familiar name of Squeakers conferred on them ; and by the South Australian aboriginals they are termed Tungoos in the only part of the State in which they appear still to exist. In Western Australia they are sometimes known by the name of Bodie Rats, but this term appears to be one of rather varying connotation. The rhinarium is naked and flesh coloured. The ears are short and rounded. The claws of the manus are large. The hind feet are longer than the head, and their soles are naked and granular. Among the generic external characters usually included are those of a crested and somewhat prehensile tail ; these two

characters are, however, lacking in the only species of whose present existence in this State I have any definite evidence. The skull is stoutly built. Palate with large vacuities between the rows of molar teeth. Dentition I. $\frac{3-3}{1-1}$. C. $\frac{1-1}{0-0}$. P.M. $\frac{2-2}{2-2}$. M. $\frac{4}{4}\ \frac{4}{4}$. The premolar teeth are remarkable structures, the tooth present in the adult being enormously elongated and fluted upon its surface in a very remarkable manner. The number and condition of the molar teeth is very variable. Three skulls of *B. penicillata* in my possession show molar formulas as follows :— (A) M. $\frac{5-5}{5\ \ 5}$, (B) M. $\frac{4-5}{4-5}$, (C) M. $\frac{4-4}{4-4}$, and in the last skull the fourth molars are mere vestiges.

The different species of Tungoos are particularly difficult to discriminate, and it is much to be regretted that animals, which were extremely abundant not many years ago, have not been studied more exactly, or their remains preserved in greater numbers in Australia.

Four recognised species are contained in the Genus, and two of these are, or have been, represented in this State. One species still lingers in certain districts, but is not likely to survive for long. Upon St. Francis Island in the Great Australian Bight there was an animal which was almost certainly a species of *Bettongia*. This creature has been exterminated in recent years, since its presence was considered undesirable by the settlers, and of it not a trace remains.

KEY TO THE TWO RECOGNISABLE SOUTH AUSTRALIAN SPECIES.

External characters—

(A.) Tail clothed with short hair, scarcely crested, not prehensile, usually white at the tip. (1) *B. lesueuri.*

(A^1.) Tail crested on its dorsal surface in its distal portion, said to be prehensile, usually not white at the tip. (2) *B. penicillata.*

Cranial characters.—

(A.) Upper premolar more than 7·5 mm. long, its long axis in line with the rest of the teeth. Bullae large, reaching upwards of 12 mm. below the level of the glenoid fossa. Snout region short ; skull strongly ridged. (1) *B. lesueuri.*

(A^1.) Upper premolar less than 7·5 mm. long, its long axis deflected outwards in front. Bullae smaller, reaching only about 11 mm. below the level of the glenoid fossa. Snout region long ; skull little ridged, smoothly rounded. (2) *B. penicillata.*

Although the external characters are so variable, and form such comparatively inconclusive guides to the species, the cranial characters and dental distinctions are well marked. Moreover, the physiological distinctions between the two species are even more pronounced. *B. lesueuri* is a burrowing animal, living, as a rule, in rabbit warrens ; while *B. penicillata* constructed a nest in a hollow scratched in the ground. *B. lesueuri* is a rather intractable creature and a fierce fighter, while *B. penicillata*, judging from such accounts as have been published, seems to have been a docile and gentle animal.

1. Lesueur's Rat Kangaroo.

Bettongia lesueuri (Quoy and Gaimard, 1824).

This animal, referred to in most works on Australia as Gray's Rat-Kangaroo, is, so far as I can ascertain, the only species still living in South Australia; moreover, it is the only one of which a skin or a mounted specimen has been preserved in our State collection.

In certain districts it is still by no means rare, but its decrease in numbers has been so rapid during the past twenty years that probably the remnant still existing must not be regarded as a very long lived one.

The animal may be described as being shaped on the whole like a little stoutly-built kangaroo, as being about the size of a rabbit, with a short blunt head and little round erect ears. In general colour it is yellowish-grey, the ventral surface being lighter, and the manus, pes, and tail distinctly more yellow. The head is blunt, the face is greyish-yellow, becoming more markedly yellow upon the lips and cheeks. (*See* Figure 153.) The hair of the dorsal surface is 21 mm. in length. The root of each hair is white, then follows a smoky-grey portion, which again gives

Figure 153.—*Bettongia lesueuri.* Characters of the head; from an adult male South Australian specimen. Three-quarters natural size.

place to yellowish-white, and the tip itself is black. Upon the sides of the body the black tips are shorter, and on the ventral surface they are absent, the colour of the fur being there conspicuously yellow. Gould noted many years ago that the coat colours of many marsupials faded in a rather remarkable manner, and that skins which had been displayed in museums often gave a very false idea of an animal's true colouration. In the case of *B. lesueuri* the fading of the yellow colouration is very remarkable, and it is therefore difficult to estimate the true specific nature of coat colour when the descriptions are written from a collection of preserved skins.

The instability of this yellow colouration is also shown by the fact that it is removed by the action of alcohol used in the preservation of specimens.

The manus and pes are clothed with short yellow hairs upon their dorsal surface. The tail is shorter than the head and body: it is clothed with short yellow hairs,

which are longer on the dorsal and ventral surfaces than they are on the sides, but no distinct crest is developed. In some specimens the tip of the tail is white, but in some it remains yellowish throughout. This variation in the colour of the tip of the tail does not appear to depend upon age, sex, or district. The tail of the living animal affords no indication whatever of being prehensile.

The ears are short and rounded. They are clothed with short yellowish fur upon their outer surfaces, and are naked within. Below and behind the ear there is a rather distinct tuft of soft yellowish hair, rather like the tuft behind the ear in some of the *Phalangeridae*. The processus antihelicis is present as a curved elevated ridge; a smaller process is just recognisable distal to the main process. The ear is carried well away from the head, and is not folded during sleep. The rhinarium is naked, tessellated in texture, and pink in colour; it is continued to the upper lip, which is deeply cleft in the mid line.

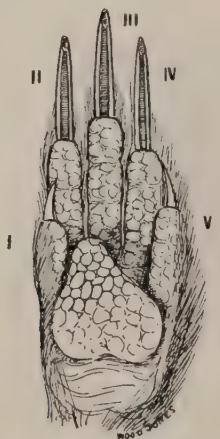

FIGURE 154.—*Bettongia lesueuri*. Palmar surface of left manus. Twice natural size.

FIGURE 155.—*Bettongia lesueuri*. Plantar surface of left pes. Natural size.

The eye is black. The eyelashes are short and black, and they are scanty in number. The facial vibrissae are fairly well developed, all sets being represented. The supraorbital vibrissae form a group of three or four, of which one is the longest (45 mm.) of all the facial bristles. The mysticial set is arranged in five rows, and the longest vibrissa is 35 mm. All the facial vibrissae are black. One white ulnar carpal vibrissa, 15 mm. long, is recognisable in the adult.

The manus has a naked, granular palm; there is a single central granular pad of a somewhat irregular shape. (*See* Figure 154.) The claws are elongated, that of the third digit being the largest. The digits are hairy to their tips on the dorsal

surface, the hair extending over the base of the claws. The digital formula is $3 > 2 > 4 > 5 > 1$. The elongated pes has a coarsely granular sole, the granules being horny and scale-like. (*See* Figure 155.) The sole, with the exception of the

FIGURE 156.—*Bettongia lesueuri*. Skull of an adult. One and a half times natural size.

pad at the base of the enlarged fourth digit and the heel, is covered by the long stiff yellow hairs which grow under the sole from the margins of the foot. The digital formula is $4 > 5 > 2\cdot3$.

The pouch is well developed, the opening is at its anterior end.

The nipples are two in number.

The skull is stoutly built. (*See* Figures 156 and 157.) It is broad and flattened, and in its general appearance it is somewhat reminiscent of the skulls of certain of the *Phalangeridae*. The muzzle region is short; the top of the skull between the orbits is flat and sharp-edged. The suture line at the posterior ends of the frontal bones is singularly variable; it may run straight from side to side; it may be gently curved, convex backwards; or it may be acutely angulated with the apex in the middle line at the back. All these varieties may be seen in skulls collected from one very limited area. The bullae are enormous, and so thin as to be semi-transparent. The permanent premolar tooth is a very extraordinary structure, and it exceeds the combined

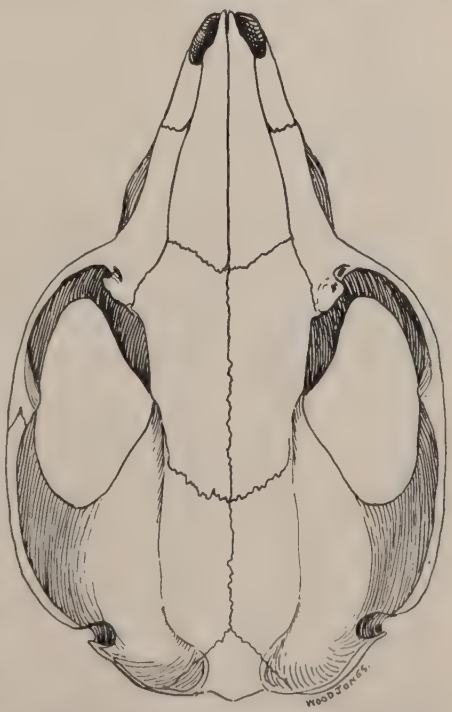

FIGURE 157.—*Bettongia lesueuri*. Dorsal view of the skull of adult. One and a half times natural size.

lengths of the two molar teeth placed immediately behind it, and its long axis is in line with theirs. (*See* Figure 158.) The grooves upon its surface are deeply sculptured. The molar teeth are very variable in number and in size, the hinder members of the series being especially inconstant in their characters.

DIMENSIONS.

	Typical ♂ from Lake Phillipson.	Brit. Mus. W.A.	Brit. Mus. W.A.
Head and body	370	457	420
Tail	300	290	260
Hind foot	105	103	98
Ear	40	29	30

It will be noticed that the animal at present living in South Australia is considerably smaller than the typical Western Australian form. Moreover, it possesses a tail, a hind foot, and an ear which are relatively considerably longer.

DIMENSIONS OF SKULL.

	Lake Phillipson.					Brit. Mus.
Basal length	64	68	62	62	59	64
Breadth	45	46	43	42	41	45
Nasals, length	27	28	25	26	25	26·5
Palate length	36	—	35	34	34	40
Bulla below glenoid fossa	19	18	—	16	18	—
Premolar length	8·5	9	9	9	—	9·6

This Rat Kangaroo, which is probably the only living representative of the Sub-family left in South Australia, is still existing in some numbers in certain districts in the North-West. Here it lives in company with the rabbits, sharing the larger warrens with them, and preferring the warrens constructed amongst the sand ridges of the typical sand hill and claypan country. The choice of a warren seems largely to be determined by the quantity and nature of the herbage in the neighbourhood, for in these waterless districts Rat Kangaroos are dependent on the succulent sand hill vegetation. Rabbits are so universally spread over the country that there probably does not exist to-day a *Bettongia* colony living in its own burrows. It has thrown in its lot with the rabbit, and although it appears to have its own appartments in the complicated system of the large warrens, it is merely a tenant, forming a part of a community in a manner which is rather remarkable when its exceedingly pugnacious character is considered. Nevertheless, though it lives in apparent harmony with the rabbits, and avails itself of the shelter of their burrows, it is suffering for the partnership. The

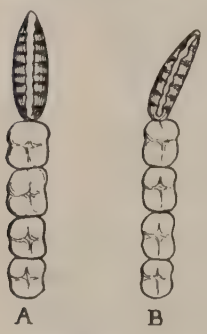

FIGURE 158.—Diagram of the upper cheek-teeth of the left side, A. of *Bettongia lesueuri*. B. of *Bettongia penicillata*. Note the outbending of the premolar tooth in the latter.

remnant of the Tungoos is living in an environment in which there is a severe competition for succulent food. In good seasons there is enough juicy herbage for cattle and rabbits as well as Rat Kangaroos but in bad seasons the rabbits and the marsupials perish in large numbers. Such losses among the rabbits are soon made good, but with the marsupials this is not the case, and probably the end of the Tungoo is not far off. When times are bad, and when the cattle and rabbits have eaten all the herbage of the sand hills, the Tungoos become extremely bold, and will enter a homestead in their search for anything to eat. They will come into a room and boldly face a cat in order to obtain some potato peelings; they will scramble over a paling fence four or five feet high in order to get at the vegetable garden. They are bold and enterprising little animals which have made, and are making, a brave struggle against what seems an almost inevitable extermination. In the more cultivated districts of the South, where food is in plenty, the wholesale scattering of poisoned pollard has led to their complete extinction. The poison cart has done its deadly work on the slowly-breeding Tungoo, although the rapidly-breeding Rabbit has survived the ordeal. In the North they are steadily being pressed out of existence by the competition for food.

When we remember that their numbers in rabbit warrens, even near to towns, was a source of constant annoyance to rabbiters less than twenty years ago, we can realise how destructive to the native herbivorous fauna the wholesale spreading of poisoned grain has proved to be. Nor must we forget that the remnant which still struggles on in the North is now exposed to the ravages of the fox.

Tungoos are strictly nocturnal, and although they are gregarious in the sense that more than a single pair may inhabit a large warren, they do not live at the present time in what could be termed communities. Although the examination of their tracks on a sandhill might lead one to suppose that a very large number of animals inhabited the district, it will usually be found that the multiplicity of tracks is the product of, maybe, no more than a single pair. When the animal is hopping in rapid gait, the track consists merely of the print of the two long hind feet, but when it is feeding there is added the continuous, tortuous, impression of the tail. These tail tracks of the Tungoo have often been taken as indications of the presence of snakes, and at first sight the twisting marks upon the sand may easily be misinterpreted.

The animals are extremely cautious, and a considerable amount of patience exercised in watching warrens on moonlight nights has not been rewarded with the sight of the creatures living their natural life. The only way to obtain living examples is a systematic excavation of the extensive warrens in which they live. Some idea of the difficulty involved in this may be gathered from the fact that, on one occasion, it took three men, in the neighbourhood of McDouall's Peak, more than a day to obtain a single specimen from a complicated warren from which six rabbits were dug out before the Tungoo was met with. They are hardy; five specimens obtained in the North-West travelled 650 miles by varied conveyances, and spent three weeks on the trip, within the confines of a box in which there was little spare room. They all arrived well in Adelaide, and thrived and reproduced in captivity. In confinement their whole activities are at first directed towards escape, and to effect this they will gnaw through wood, break through wire netting,

and dig under or climb over most obstacles. When handled, they frequently evince resentment by hissing, but when suddenly startled, and often when starting on their evening activity, they produce a short, sharp, grunt, which is an altogether surprising and unexpected sound which seems quite unsuited to the animal which produces it.

The males and females differ considerably in disposition, the males being wild and pugnacious, the females considerably more docile. A female may, as a rule, be readily handled ; but a male will bite and scratch with some severity if an attempt be made to pick him up. Even if kept in large runs when in captivity the males will fight to the death. The method of fighting is exactly like that which is employed by Bandicoots, one animal pursuing and scratching the fur from the other as it jumps over it. In this way the victim is worn out ; and, plucked of its fur, and scored by deep furrows produced by its rival's strong claws, it dies of exhaustion.

The usual position of repose is a sitting, hunched-up posture, often with the tail brought forward between the legs after the fashion of some of the wallabies. They drink little, if any, water in captivity, and thrive on any green stuff, roots, and biscuits.

They are extremely alert, and seem to be always awake, and both hearing and vision appear to be extremely keen. One young is produced at a time, and it leaves the pouch in November, after a pouch life of nearly four months. They breed freely in captivity, and could readily be re-established in sanctuaries.

2. Tufted-tailed Rat Kangaroo. Squeaker.

Bettongia penicillata (Gray, 1837).

Bettongia ogilbyi (Gould, 1841).

As far as can be ascertained at present, this animal seems to have disappeared from South Australia. It is possible that it may prove to be still living somewhere in this State, and if there is any hope of such a survival it would seem that the South-East or the extreme North-East holds out the greatest promise.

Not only does it appear to have died out completely over the greater portion of the State, but no specimen of the South Australian form seems to have been preserved in the zoological collections in Australia. At present, so far as this State is concerned, the race is represented only by some half-dozen skulls. Since it is only recently that the specific distinctions of several South Australian species have been recognised as marking them off from the allied forms of the eastern and western States, this absence, in Australia, of specimens from this State is the more to be regretted. The animal described by Gray as the type of the species *Bettongia penicillata* came from New South Wales ; and there are some grounds for supposing that the South Australian animal, distinguished by Gould as *Bettongia ogilbyi* (since merged with *B. penicillata*), did not exactly conform to the type from New South Wales. In the absence of any specimens of the South Australian form from which a description may be written, I shall quote the original description of *B. ogilbyi* from Gould, with notes from the later works of Waterhouse and of Krefft ; preferring this to giving a description of the still-existing animal from New South Wales.

Size smaller than Lesueur's Rat-Kangaroo, the weight of the animal being about three or four pounds. Fur dense, the under-fur very abundant, soft, long, and woolly. General colour brown, obscurely washed with yellow on the sides of the face and body; under-surface of the body dirty yellowish-white. Ears clothed with yellow hairs. Pes brown, darkest on the sides, especially of the toes. Manus paler brown. Tail well clothed, a very small portion of the base covered with fur, like that of the body; beyond this and extending to about the middle of the tail, the hairs are of a rusty hue on the upper side and a very pale-brown on the under side. The apical half of the tail is clothed with black hairs, which vary from 15-20 mm. in length, those nearest the tip being the longest. On the sides of the tail the hairs are comparatively short, and, excepting at the tip, they are of a deep-brown colour. On the underside of the apical half of the tail the hairs are longer than on the sides, and are of a black colour. The hairs of the dorsal surface of the body are rather broadly annulated with pale rusty-yellow, sometimes rusty-white, and at the point they are blackish-brown; the longer interspersed hairs are black. The fur, both of the upper and under parts of the body, is grey at the base.

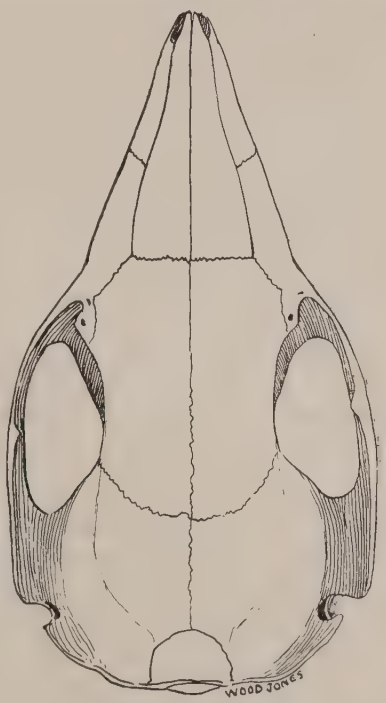

FIGURE 159.—*Bettongia penicillata*. Dorsal view of the skull of an adult. One and a half times natural size.

The skull is lightly built and delicate; the muzzle region is long and narrow, the posterior margins of the nasal bones square. The whole skull smoothly rounded without marked ridges. (*See* Figure 159.) The bullae are large, their lowest point being some 10 mm. below the level of the glenoid fossa. The upper premolar is about 7 mm. in length, its axis bent outwards from the line of the cheek teeth in front; it is marked by seven or eight grooves.

DIMENSIONS.

	Skin. Brit. Mus.
Head and body	390
Tail	310
Hind foot	108
Ear	25

DIMENSIONS OF SKULL.

	S.A.	S.A.
Basal length	61	61
Breadth	38	39
Nasals, length	27	28
Palate length	36	36
Distance of bulla below glenoid fossa	11	11

Only a few years ago this animal was extremely common over the greater part of South Australia. Twenty years ago the dealers in Adelaide did a great trade in selling them by the dozen at about ninepence a head for coursing on Sunday afternoons. It may surprise people who remember those days to know that there is not a preserved specimen, not even a skin of the animal, available for scientific study in South Australia to-day. In the same way it will one day surprise the rising generation when they realise that the few native animals they are now familiar with are gone for ever.

The Tufted-tailed Rat-Kangaroo constructed nests of grass and sticks, which were, as a rule, concealed beneath the surrounding vegetation, and therefore difficult to detect. Often the nest was constructed beneath the dependent leaves of a Blackboy (*Xanthorrhoea*), and the nest was occupied either by a single animal or by a pair.

The curious feature connected with the animal's nesting habits was the fact that it was said to carry the grass with which its nest was constructed by curling the tip of its prehensile tail around a wisp. Gould figures the animal thus employed, and states that he had observed them performing the same action in captivity. I know of no more recent observations upon this prehensile action of the tail. Like the Bandicoots, the Rat-Kangaroos always covered up the entrance to the nest, thus making the detection of their home more difficult.

They were wonderfully nimble animals, and Krefft records seeing one get over a close palisade fence 8ft. in height; but they were not very fast, and were easily caught, even by "common dogs."

It is much to be hoped that, should some remnant of the South Australian race be found still living in the more bush-covered portions of the South or of the North-East, steps will be at once taken that it may be preserved and protected by every possible means.

3. St. Francis Island Rat Kangaroo.

Upon St. Francis Island in Nuyts' Archipelago there lived, during the time of the present occupiers, large numbers of what was evidently a species of *Bettongia*. Since the mammalian fauna of the islands of the Bight has proved, in so many instances, to exhibit distinctions from the types inhabiting the mainland, it is worth while recording what can still be ascertained concerning this interesting and recently exterminated animal.

When the island was first settled, some forty years ago, "Rat-Kangaroos," or "Tungoos" were swarming. The animals do not seem to have formed burrows, but they lived in the undergrowth, and used frequently to hop into the homestead to

take bread or other eatables thrown to them from the table. They do not appear to have been nocturnal; they do not seem even to have been afraid of the human invaders of the island. Their only offence seems to have been that they had a liking for the garden produce of the family who settled on the island.

Cats were introduced in order to exterminate the Tungoos, and their work has been done completely. To what species the animal belonged can never be known and the fact of its extermination in this manner is much to be regretted.

There are many islands in the vicinity of St. Francis to which some members of the original colony could have been transported, and so given a chance to survive.

The story is one of importance from the point of view of legislation for the protection of insular faunas, since it demonstrates clearly how rapidly and how completely an interesting island fauna may be destroyed and lost to science for ever.

It is much to be hoped that *Isoodon nauticus*, *Petrogale pearsoni*, *Thylogale flindersi*, *Leporillus jonesi*, and *Rattus murrayi* are not permitted to follow the Tungoos of St. Francis Island into the ranks of recently exterminated animals.

Genus 3.—CALOPRYMNUS (Thomas, 1888).

This Genus was created by Oldfield Thomas for the reception of the animal termed the Plain Rat-Kangaroo by Gould. The Genus contains only one species and is separated from *Bettongia* and the other allied Genera by the peculiarly broad and flattened form of the skull and by certain dental peculiarities.

Plain Rat-Kangaroo.

Caloprymnus campestris (Gould, 1843).

The following description is taken from previously published accounts:—

General form slender and delicate. Face peculiarly broadened between the orbits, and the head short. Fur very long and soft, under-fur thick and abundant. General colour a distinct pale ochreous yellow, but pencilled with black; darker on the back and brighter on the sides. The hairs of the back are grey at the root, yellow in the middle, and then blackish, followed by a long yellowish-white interval, the tip being black. Under-fur slate coloured at base, then dull sandy, the tips being brown on the top of the head and centre of the back, rich sandy rufous on the sides, it being the colour of the under-fur that gives the prevailing sand rufous tone to the whole animal. The chin, sides of the chest, and abdomen pale sandy white, centre of chest naked in all the specimens examined, and apparently glandular. On the ventral surface the fur is grey at the base and yellowish-white at the tips, but on the lower part of the abdomen the grey is lacking. The upper lip is white. Fore and hind limbs bright yellowish rufous. Manus brownish-white, pes yellowish-white. Hairs of manus and pes short, not hiding the claws. Claws of manus long and white. The rhinarium is naked and broad. The ears are short and rounded and well clothed with yellowish-white hairs internally, and brown hairs externally except at the base behind, where they are white. The tail is moderately long and slender, sparingly clothed with pale hairs on its upper surface and at the sides. Through the short hairs of the upper surface scales are visible. On the under side of the tail the hairs are more dense, harsher and brownish-white in colour.

The skull is remarkable for the peculiarly short broad muzzle, with large and enormously wide nasal bones. In this feature it differs from any other marsupial skull. The last premolar shorter than that of *Bettongia*, and with only a few shallow grooves placed vertically. The molars more complex than those of *Bettongia* and more nearly resembling those of *Aepyprymnus*.

DIMENSIONS.

	♂ Brit. Mus.
Head and body	440
Tail	360
Hind foot	121
Ear	31

DIMENSIONS OF SKULL.

	♂ Brit. Mus.
Basal length	59
Breadth	41·5
Nasals, length	34
Palate length	37
Premolar length	6

The history of the Plain Rat Kangaroo is a remarkable one. It was first described in 1843 by Gould, and by him it was said to live on the stony tablelands and open plains of the northern part of South Australia. The three specimens collected by Sir George Grey, which Gould described, are in the British Museum, the skull of the oldest individual being figured both by Waterhouse and by Oldfield Thomas. There is no hint in Gould's work that the animal was a rare one, but the remarkable fact concerning it is that it has apparently never been collected since. There is no trace of the animal in any Museum in Australia, and no further specimens have ever been received by the British Museum. The probability is that it has become extinct, and that three skins and skulls are all that remain of one of South Australia's most remarkable animals. *Caloprymnus campestris* furnishes yet another example of an animal which has probably passed away comparatively recently without any trace of it having been preserved, not only in the Museum of its own State, but in any scientific institution in Australia.

Genus 4.—POTOROUS (Demarest, 1804).

The Rat-Kangaroos contained in this Genus are small creatures and considerably more rat-like than the members of the other genera of the Sub-family. The hind limbs are comparatively short, and thereby the likeness to the kangaroos is largely lost. The rhinarium is naked. The ears are short and rounded. The claws of the manus are long, slender, and gently curved. The claws of the third and fourth digits are far longer than those of the others. The tail is uniformly clothed with short closely adpressed hairs, and has no crest. Dentition I. $\frac{3-3}{1-1}$. C. $\frac{1-1}{0-0}$. P.M. $\frac{2-2}{2-2}$. M. $\frac{4-4}{4-4}$. Three species are contained in the Genus, and the history

of them is remarkable. *Potorous gilberti* and *P. platyops* were discovered in 1840 by J. Gilbert, who collected for Gould. Both species were captured in the neighbourhood of King George's Sound, Western Australia, and neither has been recorded since. The third species, *P. tridactylus*, which is still present in Tasmania, is said to have also been an inhabitant of South Australia. Unfortunately there is at the present time no living member of the Genus in South Australia, nor is any preserved material available of the form which is said to have lived in South Australia available for description or study. The description of the species which at one time inhabited this State is therefore taken from previously published accounts supplemented by examination of the still-surviving Tasmanian form.

Potoroo or Common Rat-Kangaroo.

Potorous tridactylus (Kerr, 1792).

The name "common" Rat-Kangaroo although that used in all books dealing with the marsupials, is a sadly inappropriate one. If the animal has a familiar name, the one by which it should be known is Potoroo, this being the name employed by John White, Surveyor-General of the settlement of New South Wales (1790), and by John Hunter, who studied the anatomy of the specimens which White collected and sent to London; and this, being a native name, should be conserved. Even the name *tridactylus* is an incorrect one, since it indicates that the pes has only three digits, whereas one of these digits is the syndactylous element, and only the first digit is absent. The size of the animal may be compared to a small rabbit. The general colour is a rather warm dark-brown, grizzled by the admixture of white tipped hairs. The fur is straight, sleek, and shining, and the coat mainly consists of under-fur. The hairs of the mid-dorsal region measure 30 mm., and are smoky-grey at the base, brown over the greater part of the shaft, and then with a white band of variable breadth succeeded by a brown tip.

Head and face without definite markings, but cheeks somewhat lighter and purer brown than the crown of the head; the region round the eye slightly darker than the cheeks and muzzle. Ears brown. Whole of dorsal surface brown, grizzled with white, slightly darker towards the hind end. The body colour becomes lighter and more rufus on the sides, and on the ventral surface it is fawn; the bases of the hairs being smoke-grey. Manus and pes clothed with short grey-brown hairs, the hair not extending over the nails. Tail a little more than half the length of the head and body, clothed with brown body fur at its base, then by short closely adpressed hairs, the hairs becoming darker and more sparse as they are traced towards the tip of the tail. In some specimens instead of the tail darkening uniformly to almost black at its tip, the darkened portion is suddenly followed by a white tip. Between the sparse hairs of the terminal portion of the tail scales become visible. The scales are placed in even rows, with an average of 14 rows to the centimetre. The ears are rather short, rounded in outline, and the outer surface is clothed with dark-brown hair. The rhinarium is naked, granulated, and black in colour; the naked portion extends some way back upon the dorsal surface of the muzzle. The nostrils are lateral and slit-like. The eyes are dark-brown. Eyelashes are black, and are short and fine; they are present upon both eyelids. Facial vibrissae well developed. The mysticial bristles are mostly dark, but the hinder members

of the series are paler, their tips being almost white. The longest vibrissa is 60 mm. The supraorbitals are dark, and measure only 20 mm. The genal set is not well marked. The manus has naked granular palms with ill-defined pads. The digital formula is $3 > 4 > 2 > 1 > 5$. The sole of the pes is entirely naked and coarsely granular. The digital formula is $4 > 5 > 2{\cdot}3$. The pouch is well developed, the opening being forwards; the nipples are four in number. The skull is elongated. The canines are small and thin, the last premolar, though elongated, is far smaller than that of *Bettongia*, and is marked by two or three shallow grooves.

DIMENSIONS.

	♂ Brit. Mus. Tasmania.	♂ Skin. Tasmania.
Head and body	410	320
Tail	230	180
Hind foot	81	74
Ear	35	35

DIMENSIONS OF SKULL.

	♂ Brit. Mus. Tasmania.	♀ White's Original Potoroo.
Basal length	82	66·5
Breadth	45	39
Nasals, length	45	35
Palate length	56	40

Of the former distribution of this animal is South Australia no details can now be obtained. Save the bare record of its existence in this State, which is given in the British Museum catalogue of 1888 and which has been copied into all subsequent works, I know no other reference to the creature as a South Australian animal. Its habits seem to have been but little studied, and it is high time that a good series of observations be made of the still surviving Tasmanian form. The remaining Potoroos should be carefully protected in those places where they still survive, and efforts should be made for turning them down in properly safeguarded sanctuaries. If this is not done there seems to be no doubt that the remnant of the stock will share the fate of the South Australian form and rapidly become extinct.

Sub-Family III.—MACROPODINAE.

The Sub-family contains the typical Kangaroos and Wallabies, the best known of all the marsupials, and the most distinctive specialisations of the Australian Didelphians.

All the members of the Sub-family have the following characteristics in common. The claws of the manus are not unduly elongated, and the claws of the median digits

are not disproportionately longer than those of the lateral digits. The ears are elongated and oval in outline. The canine teeth are rudimentary or absent. The upper central incisors are not disproportionately larger or longer than the other incisor teeth. Dentition I. $\frac{3-3}{1-1}$. C. $\frac{1-1 \text{ or } 0-0}{0-0}$. P.M. $\frac{2-2}{2-2}$. M. $\frac{4-4}{4-4}$. With regard to the terms kangaroo and wallaby, there is but little uniformity of usage, and the size of the adult animal is usually taken as the criterion by which any species should be classed in the one group or the other. It therefore often comes about that an animal which in one State is known as a wallaby is termed a kangaroo in a neighboring State. An attempt to delimit the use of the terms by some definite criterion meets with only partial success. If an arbitrary standard is fixed, popular usage will still render the nomenclature inexact. It is a sufficiently precise definition to lay down that an animal is termed a kangaroo only when the length of the pes of a typical adult exceeds 250 mm., all the members of the Sub-family with shorter feet being known as wallabies. On the whole such a definition fits in with the average popular usage of the terms; but a difficulty is met with in the case of the animals always known as Tree Kangaroos, which, judged by the foot length, should be rather termed Tree Wallabies.

Two divergent stocks are included within the Sub-family. The one stock is characterised by possessing high crowned (hypsodont) molar teeth and small premolars, the other by low crowned (brachydont) molars and greatly developed sectorial premolars. These two sections are readily separated. The further splitting up of the Sub-family is, however, a matter of some little difficulty, and on the whole it is true to say that no very satisfactory subdivision into Genera can be made by external characters alone. Here a table based partly on dental characters and partly on such external characters as the features of the tail will be employed.

(I.) *The Hypsodont Section*, with high-crowned molars, and the premolar teeth smaller than the molars.

(A.) With the two upper rows of incisors nearly parallel. Incisors broad, flat-topped. 1^1 smaller than 1^2. Genus 1. *Lagostrophus.*

(A¹.) With the two upper rows of incisors widely divergent backwards. Incisors narrow, sharp-edged. 1^1 larger than 1^2.

(B.) Distance between 1^3 and the premolar (diastema) less than the length of the first three molars. Genus 2. *Lagorchestes.*

(B¹.) Distance between 1^3 and the premolar (diastema) equal to or greater than the length of the first three molars.

(C.) The tail ending in a terminal tuft.

(D.) Molars $\frac{7-7}{7-7}$. Genus 3. *Peradorcus.*

(D¹.) Molars $\frac{4-4}{4-4}$. Genus 4. *Petrogale.*

(C¹.) The tail not ending in a terminal tuft.

(E.) With a cornified "nail" at the tip of the tail. Genus 5. *Onychogale.*

(E¹.) Without a cornified "nail." Genus 6. *Macropus.*

(II.) *The Brachydont Section*, with low-crowned molars and the large sectorial premolar exceeding the molars in size.

(A.) Without canine teeth. Tail very short. Genus 7. *Setonyx.*

(A[1].) With canine teeth. Tail well developed.

(B.) Pes shortened, claws curved. Arboreal.

Genus 8. *Dendrolagus.*

(B[1].) Pes elongated, claws straight. Terrestrial.

Genus 9. *Dorcopsis.*

The members of the Sub-family Macropodinae are so universally associated with Australia and all things Australian, that it might be imagined a national spirit would exert itself to preserve and cherish what is practically a national emblem. This desirable trend of public spirit has not yet come into being, and in general the fate of the kangaroos and wallabies may be summed up by saying that Australia is converting its national emblem into boot leather.

In some States the animals are afforded partial protection, but in others they are totally unprotected by legal enactments. In this State the close season is from July 1st to December 31st, and the Rock-Wallabies are totally protected, but since these animals live mainly upon the borders of States where protection is absent, and their skins are not marketed here, this total protection is only nominal. It is to be noted that the open season, when animals may be legally slaughtered, covers the period of the dependent pouch life of the young animal. It therefore happens that most females which are killed in the open season are killed with the young in the pouch.

That kangaroos and wallabies when numerous are capable of doing a considerable amount of damage to crops, and that they eat a quantity of herbage that might otherwise be grazed by sheep, is perfectly obvious; but the rabbit has been doing all that for a great many years.

By the terms of the Animal and Birds Protection Act, 1919, any owner of land may kill, or authorise others to kill, any and all protected animals at any time if it is for the *bona fide* safeguarding of his property: provided that no carcass or skin of such animals be sold. This provision of the Act completely deprives of any sort of justification the periodic attempts to remove these animals from the partly protected list on the plea that in a certain district they happen to be doing some damage. The only effect of opening the close season or of removing it altogether is to permit the landowner to slaughter the animals for profit—he can always slaughter them for the protection of his property. If all the kangaroos and wallabies killed in Australia were killed solely for the protection of property, we should not now have to deplore the loss of several beautiful and interesting species, nor have to admit that no good first hand account can now be given of some of them by workers in Australia since no adequate series of specimens of them has been preserved.

It must also be remembered that the abundance of any species may be an extremely local affair, and must not be taken as an index of the general status of the species. Fences have so far restricted the movements of these animals that there may be a concentration of individuals at one point, although, taking Australia as a whole, the species may be a dying one. The removal of the close time because

of the local abundance of a species is therefore a step that should not be undertaken without some consideration.

Wallaby and kangaroo skins are marketed in Australia in enormous numbers. Probably about 500,000 skins pass through the markets of each of the large centres every year; and in Sydney at any rate this number is considerably exceeded. During 1919, 1920, and 1921 no less than 1,763,826 pelts were used in the fur market alone.

The bulk of the skins are converted into leather, the fur value of the adult pelts of most species not being high. Such skins as are absorbed into the fur market figure under a variety of guises, being sold as Wallaby, when in their natural condition, but after being subjected to various processes they pass as "Australian Fisher," "Koala," "Sydney Racoon," and "Skunk."

Kangaroos and wallabies are easily kept and bred in captivity; but the various Zoological Gardens in Australia must not be regarded as the places in which the future of these animals can be insured. The aim of all those interested in the preservation of the native fauna should be concentrated on the establishment of properly regulated reserves. In such reserves the animals will multiply rapidly, and experience has already shown that from a well administered reserve enough surplus stock can be produced to provide leather and furs as well as animals for Zoological Gardens and specimens for scientific study. Besides the formation of reserves much remains to be done towards the guiding of public opinion in the direction of a desire to preserve and not to exterminate; and in such aims the sympathy of the landowner should be enlisted. It would be a great thing that one day the landowners of Australia should be as proud of their kangaroo reserves as those of other lands are of their deer parks.

It is to be noted that, in the case of several wallabies and kangaroos, skull measurements of rather a large number of skulls are given here. In all these instances the skulls examined have been those of animals killed for commercial purposes. I am indebted to several generous correspondents for this material. At the camp sites of kangaroo hunters are skulls of animals skinned for the markets, and these skulls should be collected and forwarded to institutions in Australia by everyone having the opportunity. The amount of preserved material in Australian museums is altogether inadequate. In many cases this cannot now be remedied, for the animals have ceased to exist; but in many cases material which is much needed in our State collections is lying about only awaiting collection. I would here especially thank Messrs. Shields, of Melrose; Coulston, of Bimbowrie; and May, of Kangaroo Island, for rescuing skulls from the camp sites of kangaroo hunters and rendering them available for study and for preservation.

HYPSODONT SECTION.

Genus 1.—LAGOSTROPHUS (Thomas, 1886).

In this Genus there is only a single, rather variable, species known as the Banded Hare-Wallaby. Gould reported this animal as being an inhabitant of South Australia, but this was almost certainly an error. It seems most likely that the species has always been confined to Western Australia, and to some of the islands of Sharks Bay.

Genus 2.—LAGORCHESTES (Gould, 1841).

The animals belonging to this Genus are elegant little creatures appropriately enough known as Hare-Wallabies. Members of the Genus are distinguished by the common possession of the following characters. The rhinarium is wholly or partly hairy. The central claws of the pes are long and stout, and are not hidden by the hairs of the foot. The tail is rather short, not bushy or crested, but evenly short-haired throughout.

The skull has a short muzzle region. The diastema (the gap between the incisor teeth and the cheek teeth) is shorter than the length of the first three molar teeth. The incisors are small and sharp edged. The bullae are inflated.

Three variable species are included in the Genus ; one of them inhabits, or formerly inhabited South Australia ; the other two figuring as South Australian only in those accounts of the fauna in which the Northern Territory is included as part of this State. Since these northern species probably extend their range only a little to the south of the tropic, they will not be described in detail here.

(1) **Hare-Wallaby.**

Lagorchestes leporoides (Gould, 1840).

I know of no preserved specimens of this formerly common animal from which a description may be written of the actual form which inhabited this State. Reliance will therefore have to be placed on the details accessible in previously published accounts ; and in quoting from such accounts we must remember Gould's statement that " considerable diversity and colour is observable in different specimens, some being much redder than others, but the sexes are scarcely distinguishable by size." In general appearance the light and slenderly-built animal is very like a common Hare, the likeness being accentuated by the shortness of the head and the length of the ears. The hair is long and soft and in general colour is very like that of a Hare. The hair of the dorsal surface of the body is variegated with black, rust colour, and rusty-white, the white being most conspicuous and the rust colour but little seen save over the back of the neck and shoulders, and for a considerable space around the eye.

The sides of the body and haunches are suffused with rust colour. The ventral surface is grey-white, suffused with rust colour or yellowish, but between the hind legs the rust or yellow tinge disappears and the fur is pure white. The hairs of the dorsal surface are black at the base, banded first with reddish-brown, then rusty-white, and the tip itself is black. The hairs of the ventral surface are grey at the roots and rusty grey-white at the tips. Between the hind legs the hairs are white in the whole of their length. There is a faint and inconspicuous trace of two lateral loin bands such as are present in so many marsupials. The fore limbs have a well marked black patch on the outside of the proximal part of the forearm ; this patch is due to the absence of the longer hairs and the consequent prominence of the nearly black under-fur. The forearm itself and the manus are clothed with short brown hairs pencilled with white. On the middle of the tibia is a dusky patch. The feet are clothed with impure palish rust coloured hairs finely freckled with brown, the digits brownish. The tail is clothed throughout with short adpressed hairs, grizzled brownish-grey above, dirty white below and at the sides.

The rhinarium is completely clothed with short brown hairs, the base of the nasal septum being alone naked. The ears comparatively long and somewhat pointed at their tips; clothed internally with long white hairs, externally with short grizzled hairs.

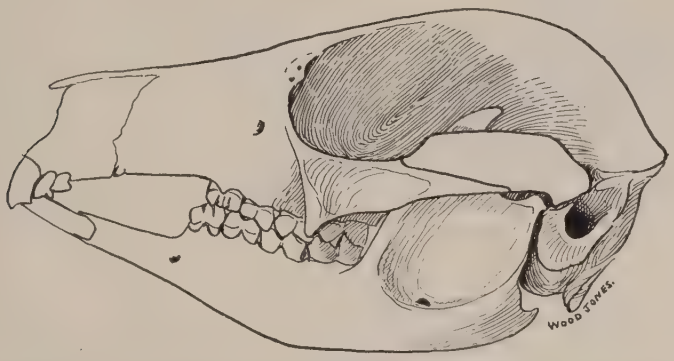

FIGURE 160.—*Lagorchestes leporoides*. Lateral aspcet of the skull of a South Australian specimen. S.A. Mus., No. M. 1736. One and a half times natural size.

The skull is light and slender, with a long narrow muzzle; the bullae are much swollen, globular, smooth, and transparent. (*See* Figure 160.)

DIMENSIONS.

	Brit. Mus. ♂ Skin. N.S.W.	Brit. Mus. ♀ Stuffed. N.S.W.
Head and body	450	490
Tail	320	300
Hind foot	128	122
Ear	45	57

DIMENSIONS OF SKULL.

	Brit. Mus. ♂ N.S.W.	Brit. Mus. ♀ S. Aust.
Basal length	79	69
Breadth	48	45
Nasals, length	37	35
Palate length	50	44

In the British Museum catalogue of 1888 five specimens in the collection are recorded as being from South Australia, and Gould noted that it was "tolerably abundant in all the plains of South Australia, particularly those situated between the belts of the Murray and the mountain ranges." I have been unable to obtain any evidence of its present existence in the State, and in all probability it is completely exterminated. Of its habits Gould records that it is "usually solitary,

and sitting close in a well formed seat " like a hare. Both Gould and Krefft have recorded its wonderful jumping powers, Krefft having observed it jump more than 8ft. high. Gould's account is graphic and is worth quoting entire. " For a short distance its fleetness is beyond that of all others of its group that I have had an opportunity of coursing. Its powers of leaping are also extraordinary. While out on the plains of South Australia I started a Hare Kangaroo before two fleet dogs. After running to a distance of a quarter of a mile it suddenly doubled and came back to me, the dogs following close to its heels. I stood perfectly still, and the animal had arrived within 20ft. before it observed me, when, to my astonishment, instead of branching off to the right or to the left, it bounded clear over my head and, on descending to the ground, I was able to make a successful shot, by which it was procured."

(2) **Leichhardt's Hare-Wallaby.**

LAGORCHESTES LEICHARDTI (Gould, 1863).

This species is larger and far more brilliantly coloured than *L. leporoides*. There is a bright rufous patch around the eye. The dorsal surface of the body is rufous, the ventral surface nearly pure white. The ears are shorter than those of *L. leporoides*. The animal was taken by the members of the Horn Expedition in the McDonnell Ranges, where it appeared to be by no means uncommon. It cannot, however, be accepted as a member of the fauna of South Australia, as this State is now delimited. It may be noted that Leichhardt's name was incorrectly transcribed when used for this species.

GENUS 3.—PERADORCUS (Thomas, 1904).

This Genus was constituted by Oldfield Thomas for the reception of the aberrant Wallaby known as the Little Rock-Wallaby, (*Peradorcus concinna* Gould, 1842). The animal has been found only in the far North-West of the continent.

GENUS 4.—PETROGALE (Gray, 1837).

This Genus contains the beautiful Rock Wallabies, characterised, for the most part, by adaptations to their environment of the open rock-strewn ranges.

These adaptations naturally concern the method of progression and therefore affect the pes and the tail most markedly. The tail being used far more as a balancing organ than as a fulcrum employed in slow progression, is well clothed with longish outstanding hair, and tufted at its extremity. It is not thickened at its base as is the tail of the kangaroos and scrub wallabies, but is cylindrical and devoid of the thickened pad present in the tails of other forms. In harmony with this fact the skin can be stripped from the underlying tendons and bones as can be done in the case of an ordinary rat, whereas in the kangaroos and scrub wallabies the skin is adherent to the thickened tail pad.

The pes is padded and strongly sculptured with granulations on the sole. The nails are short, and a fringe of stiff hairs outlines the margins of the sole and of the

digits. (*See* Figure 163.) Another modification which at first sight seems to have a less direct association with environment is the naked rhinarium. (*See* Figure 161.) But it is instructive to note that the same modification is present in the Euro (*Macropus robustus*) which shares the habitat of the rocky ranges with the Rock Wallabies.

Of the Rock Wallabies there are nine well defined species, and three of these inhabit South Australia and its islands, one of the continental species being practically confined to this State, and the insular form occurring only on a single island in the Bight.

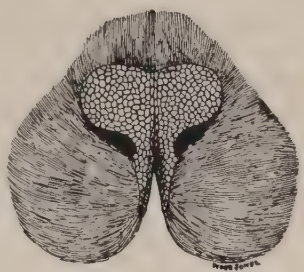

FIGURE 161.—Rhinarium of *Petrogale xanthopus*.

KEY TO THE SOUTH AUSTRALIAN SPECIES.

External characters—

(A.) Tail annulated with alternate rings of brown and pale yellow. Backs of ears uniform yellow. (1) *P. xanthopus*.

(A¹.) Tail not ringed. Ears not uniformly coloured behind.

(B.) Ears with small white patch at base. Lateral body stripes brown. (2) *P. lateralis*.

(B¹.) Ears with large white patch at base. Lateral body stripes almost black (3) *P. pearsoni*.

Cranial characters—

(A.) Skull large. Basal length more than 95 mm. (1) *P. xanthopus*.

(A¹.) Skull small. Basal length less than 95 mm.

(B.) Bullae but little inflated. (2) *P. lateralis*.

(B¹.) Bullae considerably inflated. (3) *P. pearsoni*.

Of these three species *P. xanthopus* inhabits the rocky country from the Gawler Ranges to the Flinders Ranges, and to the eastern boundary of the State at Bimbowrie and Cockburn. *P. lateralis* lives in the ranges of the far Centre, and was found by the Horn Expedition at Alice Springs and in the McDonnell Ranges, and by the Elder Expedition in the Barrow Ranges. It probably extends further to the south and west and so into South Australia proper. *P. pearsoni* is confined to Pearson Island, in the Bight.

(1) Yellow-footed Rock-Wallaby.

PETROGALE XANTHOPUS (Gray, 1854).

This is a large, handsome species, distinguished at once from all the other members of its group by the ring markings on its tail and by the uniform yellow backs of its ears. The fur is long (15-20 mm.), soft, and silky. General colour of the dorsal surface fawn grey, ventral surface white. Face and crown of the head fawn grey

becoming more brown around the eye, and behind and above the eye being replaced by a bright, almost orange, yellow patch. Starting on the muzzle and running below the eye to the ear is a well defined white cheek stripe, below which the side of the jaws becomes fawn grey again ; on the crown of the head behind the ears is a dark-brown patch which continues backwards as the mid-dorsal stripe. Ears long and clothed on their outer surfaces with uniform yellow hairs. Inner surfaces naked towards the middle of the concha ; fringed with yellowish-white hairs along the margins and at the tip.

Whole of the dorsal surface of the body fawn grey, with a median dorsal stripe of dark-brown starting between the ears upon the crown of the head and fading out tailwards so that it can only be certainly traced as a stripe to about the middle of the back. At the back of the fore limb, where it joins the body, is a dark-brown patch behind which is a white stripe, which starts upon the back of the shoulder and extends downwards towards the hip.

A similar brown patch is present in front of the hind limb where it joins the body, which again is followed by another white area. Whole of the skin, chest, and ventral surface of the body white. Fore and hind limbs uniformly yellow : dorsum of manus and pes brown. The tail abundantly haired with alternate rings of yellow and brown, about a dozen rings of each colour being usually recognisable. Terminal tuft of tail tawny yellow-brown.

Naked parts of ear dark coloured and punctate. The rhinarium is naked, the skin black in colour and tessellated in texture. The eye is dark-brown, the long black eyelashes much better developed upon the upper lid than the lower. All sets of facial vibrissae are represented, but none is very well developed, and few members of any set exceed 30 mm. in length.

The skull is larger than that of any other Rock-Wallaby, and is distinguished for its straight, elongated muzzle and its peculiarly straight lower jaw. (*See* Figure 162.)

DIMENSIONS.

	♂ S.A. Fresh.	Brit. Mus. ♀ Stuffed.	Brit. Mus. ♂ Flinders Range. Skin.
Head and body	650	680	800
Tail	650	600	600
Hind foot	170	160	170
Ear	85	70	75

DIMENSIONS OF SKULL (average of 25 South Australian skulls of both sexes).

Basal length	102
Breadth	59
Nasals, length	49
Palate length	62
Diastema	24

The Yellow-footed Rock-Wallaby is still fairly abundant in certain parts of South Australia, but from many of its old haunts it has completely disappeared. It would

seem that at the present time it is being driven mainly to the north and east of the State, and that its last stronghold in South Australia will be upon the New South Wales border. If it has not altogether disappeared from the Gawler Ranges it must now be a very rare animal, and in many parts of the Flinders Ranges its numbers are considerably reduced. From the eastern portion of the State it will almost certainly disappear before very many years are past, since its pelt is far too attractive to permit it to survive as long as the fur trade exists. Although a totally

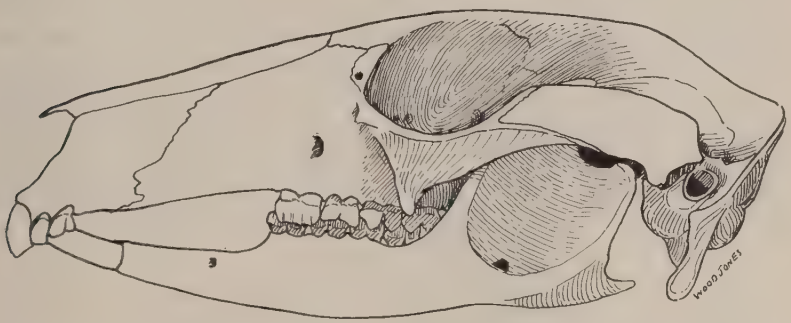

FIGURE 162.—*Petrogale xanthopus*. Lateral view of skull. Natural size.

protected animal in this State, this protection is not extended to it by certain of the States upon the borders of which it lives. It is therefore not to be wondered at that pelts of the animal are disposed of in the markets of States other than South Australia, even though the animal was obtained within the geographical boundaries of our own State.

Petrogale xanthopus is a fitting example of an animal which needs sanctuary for its preservation and more stringent legislative efforts to check its slaughter.

(2) **Black-flanked Rock-Wallaby.**

PETROGALE LATERALIS (Gould, 1842).

This distinctly marked animal is, as a rule, named "West Australian Rock-Wallaby" in works dealing with the marsupials; but since it is by no means confined to Western Australia, the name is an inappropriate one, and is here discarded in favour of the older name used above.

A considerably smaller animal than *P. xanthopus*, lightly built, and slender. The fur is rather long and soft, and is somewhat woolly in texture. General colour light brownish-grey. The head and face, the neck, shoulders, and front of fore limbs with less brown and more grey than the rest of the body. The face is grey, with a well defined dark stripe running through the eye nearly to the ear. The dark stripe being succeeded below by a whitish or yellowish stripe. Crown of

the head dark-grey, the tips of the hairs black ; the occiput is nearly black, and a line of the same dark-brown or black colour runs down the back of the neck and is distinguishable to about the middle of the back. The lower portion of the back has a more pronounced brown tinge than the upper portion of the back and shoulders. The chin, chest, and mid line of abdomen pale buff-yellow to brownish-white.

The most conspicuous marking is the lateral stripe which starts as a dark-brown patch on the elbow and runs as a dark-brown line along the side of the abdomen to the flank and along the thigh to the front of the knee. There is an almost white line just above this brown one, so that the dark stripe is outlined upon each side with greyish-white, the white of the ventral surface on the one hand and the white stripe, intervening between it and the grey of the back, on the other.

Limbs grey, with the manus and pes dusky-brown. Rhinarium naked and black. Ears rather short, clothed with dark-brown hairs on the outer surface save at the extreme tip and at a patch over the base, where the hairs are brownish or yellowish white ; internally the hairs are dirty yellowish white. Tail clothed with grey hairs in its basal half, the apical half is bushy and the hairs are dark-brown or black.

DIMENSIONS.

	♂ W.A. Brit. Mus.	♀ W.A. Brit. Mus.
Head and body	590	600
Tail	460	420
Hind foot	139	120
Ear	48	49

DIMENSIONS OF SKULL.

	♂ Brit. Mus	Brit. Mus.
Basal length	84	79
Breadth	48	48
Nasals, length	39	37
Palate length	51	49
Diastema	22	18·5

The members of the Horn Expedition found this Rock-Wallaby plentiful in, and confined to, the rocky ranges of the Centre. It appears to occupy all the hill country comprised in the area drained by the Finke and Todd Rivers. Specimens were obtained in the McDonnell Ranges, in the Barrow Ranges, and at Alice Springs. How far its range extends to the south and into South Australia I have failed to ascertain, and at present no evidence is available as to its actual presence in the State. A Rock Wallaby was abundant not very long ago in hilly country to the west of Lake Torrens, and from first hand accounts of this animal it seems most likely that it was this species. Further research in this interesting region can alone determine the point.

(3) Pearson Island Rock-Wallaby.

PETROGALE PEARSONI (Thomas, 1922).

This beautiful wallaby was only recognised as a distinct species and named and described in 1922. It is an outlying insular member of the group to which *P. lateralis* and *P. hacketti*, of Mondrain Island, belong.

The description of the type specimen is as follows:—"Size comparatively small, about as in *lateralis*, decidedly smaller than in *hacketti*. General colour, on the whole, much as in *lateralis*, paler than in *hacketti*. Dark lateral lines of the underside, however, more blackish, those of *lateralis* being dark-brown. White patches at the base of the ears larger and more prominent. Tail with its upper and under surfaces, from about 3in. from the base, contrasted black, the sides dull buffy whitish; above, the black soon fades off into the brownish terminal tuft, but below it continues to within 2in. of the tip. This tail colouration is, on the whole, more as in *hacketti* than *lateralis*, but in both there is a considerable variation.

The usual narrow black dorsal line is continued rather more definitely on to the rump than in any of our specimens of *lateralis*, but the difference may be due to this part being in fresh pelage, and so showing the line more distinctly.

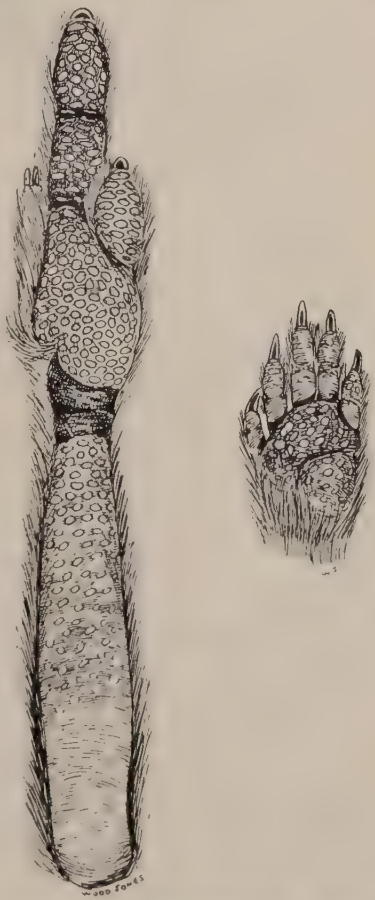

FIGURE 163.—*Petrogale pearsoni*. Left pes and manus. Natural size.

Skull (*see* Figure 164) in size and general shape quite as in *lateralis*, smaller and with less heavy supraorbital ridges than in *hacketti*. In the bullae there is a difference between *lateralis* and *hacketti* which had not been previously noticed. In the former they are fairly well swollen, anteriorly as well as posteriorly, so as to produce a transverse convexity (hardly to be called a ridge) in front of which the bone descends nearly vertically towards the level of the glenoid surfaces. In *hacketti*, however, the whole bulla is larger, but lower and more spread out, its front part evenly and gradually descending towards the glenoid level without marked transverse convexity. In *pearsoni* the bullae are most like those of *hacketti*, although perhaps a little more swollen. In making this comparison six

skulls of *hacketti* and ten of *lateralis* have been available, so that the difference is evidently fairly constant. Incisors a little larger than in *lateralis*, the whole row 10 mm. in length, about as in *hacketti*, as compared with about 9 mm. in *lateralis*. Secator also slightly larger than in *lateralis*, much smaller than in *hacketti*.

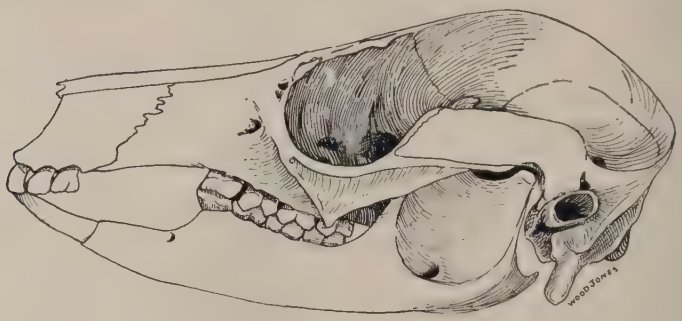

FIGURE 164.—*Petrogale pearsoni*. Lateral view of the skull of an adult male. Natural size.

Dimensions of the type (measured on the remade skin).—Head and body, 500 mm.; tail, imperfect; hind foot, 136; ear, 43. Skull—Greatest length, 94; condylo-basal length, 90; zygomatic breadth, 48; nasals 39 x 14; palatal foramina, 7·7. Length of I^3 4·5, of P^4 6·9. Combined length of M^{1-3} (unworn) 19."

The following table gives the DIMENSIONS of eleven typical skulls :—

	A	B	C	D	E	F	G	H	I	J	K
Greatest length	88	88	91	103	91	94	100	97	99	98	98
Condylo-basal length	85	81	85	95	85	89	94	89	91	92	93
Zygomatic breadth	47	46	46	52	47	47	51	47	51	—	—
Nasals, length	36	35·5	37	44	36	38	45	39	42	42	—
Nasals, breadth	13	12	13	15	13	13	14	13	14	15	—
Palatal foramen.....	7	7	7	8	7	8	7	8	8	8	7
Length of I^3	4·5	—	4·5	4·5	5	4·5	4	4	4·5	—	—
Length of P^4	5	5	6	6·5	5	5	7	7	6	6·5	6
Length, M^{1-3}	17	17	17	19	17	16	18	18	17	16	17

The length of the tail in an average specimen is 500 mm. In the skull there is very commonly developed (four times in 12 specimens) an os bregmaticum (the so-called os epilepticum of human anatomy) and even when it is absent a sutural irregularity at the bregma is usually present. (*See* Figure 165.) In a series of skulls of *Petrogale xanthopus* from Bimbowrie the same remarkable little bone occurs with about the same frequency, but so far I have not noticed it in any of the Wallabies of other Genera.

The skull is remarkable for its very light ossification, the bones of the cranial vault being extremely thin, and compared with the skulls of such Wallabies as *Thylogale* (*Macropus*) *eugenii* it can only be described as fragile. The teeth are commonly in very bad condition, and in several specimens are enveloped in masses of tartar; alveolar abscesses also occur in connection with the roots of the teeth in two skulls obtained. Like the insular bandicoots and rats, the wallabies are

usually extremely fat. The fur swarms with a *Mallophaga* which readily parts company with a dead wallaby in favour of a living human host, and the intestines of all specimens obtained contain a very heavy infection of nematode worms.

That a rock wallaby lived upon the northern portion of the northern island mass of the Pearson's group has been for years common knowledge to the men employed in the coastwise traffic of the Bight. From its diurnal habits, from its comparatively large numbers in a very limited area, and from its habit of frequenting the tops of the huge granite boulders which constitute the shoreline of the island, it is a conspicuous creature readily seen from the deck of a ship passing under shelter of the eastern side of the group.

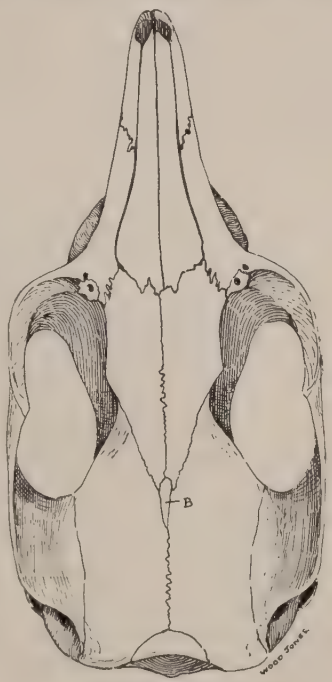

FIGURE 165.—*Petrogale pearsoni*. Dorsal view of the skull of an adult male. Natural size. (A small extra bone, the os bregmaticum, is marked B).

It is an exceedingly beautiful wallaby, its markings conspicuous in their contrasts of dark lateral body stripes, white throat and chest, and bushy tufted tail. On such level ground as the island affords its gait appears somewhat awkward, for it travels with the head low and the tail arched conspicuously upwards. It seems that for such progression it has to cant its body forwards at an ungraceful angle, for the tail is not used as a fulcrum as it is in the "scrub" wallabies and kangaroos, it is carried sheer off the ground in all gaits. When one is started across the more or less level saltbush areas it gets away at an awkward gait, using every bush for cover as it goes, but seeming to proceed more or less without regard to its bearings. When it wishes to see where its safest line of retreat lies, or where it is threatened, it stops, puts up its head, and looks around. But short of stopping it appears unable to raise its head from its rather ungraceful stoop to take in any wide view. Though it may seem an ungraceful animal in open bush country, it is a very different creature when seen upon the huge, fantastic, granite boulders which constitute the main portion of its island home. Here its movements are astonishing: there seems to be no leap it will not take, no chink between boulders into which it will not hurl itself. There is no part of the northern portion of the islands that it does not inhabit: it is at home on the naked granite boulders of the shore upon which the surf crashes, and on the lichen covered boulders of the summit, nearly 800ft. above, where moss, ferns, and casurinas of large growth constitute a very distinct type of environment. It does not exist upon the southern portion of the main northern island, and almost certainly it is absent from the southern detached portions of the group. Its area even on the Pearson Group is therefore a peculiarly restricted

one, and it is rather remarkable that it should be confined to only one of the three partially connected masses which constitute the complex northern main island.

The wallaby has no obvious natural enemy; the sea eagles, crows, and sea lions may possibly take occasional toll of young or sick, but from its habit of sitting exposed on a rock at any time of the day it would appear that there was but little threat to its safety in the normal condition of its environment. In November some females were seen with large young still in the pouch; in January and February the young were all running with the parents.

Petrogale pearsoni is one of the many zoological treasures left stranded on the islands of the Bight; it is to be hoped that it will long remain in possession of its restricted home. Pearson Island has been proclaimed as a sanctuary, and so far as legal enactments can ensure it the animal should be safe from the threat of extermination at the hands of man.

Genus 5.—ONYCHOGALE (Gray, 1841).

This Genus contains the three species of beautiful Silky or Nail-tailed Wallabies. These three species form a natural little group which derives its popular and scientific name from the fact that the tail ends in a curious horny excrescence, or nail. Although this character is usually said to be "altogether unique among marsupials, and is only found among other mammals in the Lion," we have already noted (p. 153) that in the Bilbys of the Genus *Thalacomys* a very similar cornified spur is present.

What the functions of this spur may be it is impossible to guess. As Oldfield Thomas observed in 1888, "Observations on the living animal are much needed with regard to this interesting point." I am unaware of any observations recorded since that date, and by now the chance of making observations upon living animals has passed for the South Australian naturalist.

In addition to the possession of this curious nail, members of the Genus are distinguished by their small, narrow, incisor teeth which, unlike those of the rest of the wallabies, decrease evenly in size from before backwards; the third incisor being a very slender tooth which points markedly forwards. The rhinarium is hairy, the bottom of the septum of the nose being the only naked area. The central claws of the pes are long, narrow, and compressed, and very sharp. The tail is long, tapering, short haired, not bushy, but more or less crested towards its tip.

Of the three species contained in the Genus, one (*Onychogale unguifera*) is confined to the north and west of Australia, another (*Onychogale frenata*) is confined to the eastern portion of the continent, and the third (*Onychogale lunata*) at one time ranged from the Swan River district of Western Australia eastwards into this State.

Crescent-marked Wallaby.

Onychogale lunata (Gould, 1840).

The animal is of small size, in general being comparable to a rabbit, and its form is very light and delicate. The general colour is clear ashy-grey, with a distinct crescent shaped white mark on the fore quarters which gives its popular and scientific names. The fur is soft and fine, the under-fur long, slaty-grey at the base, pale-

grey terminally. The face is grey, there is a slightly paler cheek stripe, and the area round the eye is paler and more rufous. The back and sides of the neck uniform rich rufous or "vinous rust colour," the bright colour being due to the rufous tips of the under-fur. The white shoulder stripe is very well marked; it runs from the white fur of the ventral surface of the body around the shoulder and ends abruptly on the scapular region without encroaching on the neck. The fur on the ventral surface is pale-grey at the base and white at the tips. The sides of the body are paler than the back, and have an admixture of rufous hairs. There is an ill-defined paler hip stripe. The fore and hind limbs pale-grey, manus and pes pale-brown. Tail only moderately long, clothed throughout the greater part of its length with short, closely adpressed grey hairs. The terminal portion of the tail with longer and darker hairs forming a slight crest. The horny nail at the

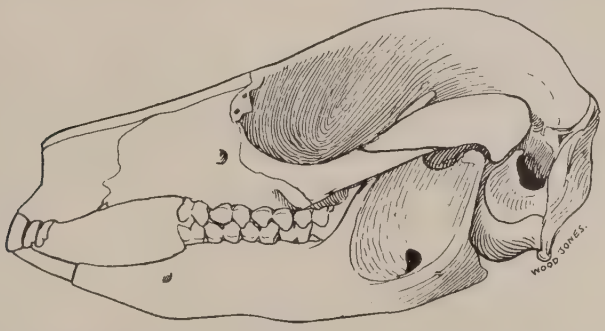

FIGURE 166.—*Onychogale lunata*. Lateral aspect of the skull of a South Australian specimen. S.A. Mus., No. M. 1731. One and a half times natural size.

extremity of the tail is rounded and some 3 mm. in diameter. The ears are of medium length and tapering towards their tips; they are clothed with long white hairs within, with fine black hairs at the apex, and with short brown hairs over their backs.

The skull is small and lightly built. The muzzle is slender and pointed. (*See* Figure 166.) The bullae are large, much swollen, and transparent. The teeth are small, the incisors in particular being very slender. The canine is usually present, but minute and functionless.

DIMENSIONS.

	Stuffed. ♂ Brit. Mus. S. Aust.
Head and body	500
Tail	332
Hind foot	120
Ear	58

DIMENSIONS OF SKULL.

	Brit. Mus. ♂ West. Aust.	Brit. Mus. ♀	S.A. Mus., No. M. 1731.
Basal length	64	61	c 60
Breadth	39	39	36
Nasals, length	28	25	22
Palate length	38	38	—

In 1884 Mr. E. B. Sanger reported the Crescent-marked Wallaby from the Centre and in the British Museum catalogue of 1888 three South Australian specimens, collected by Sir George Grey, are recorded.

The Elder Expedition in 1891 met with it in the Everard Ranges, and the skull of one of the specimens procured at that time is illustrated in Figure 166. The Horn Expedition of 1894 obtained two specimens at Alice Springs. I know of no more recent observations, and probably so far as South Australia is concerned the animal has ceased to exist. In Western Australia it is now greatly reduced in numbers and confined to a very restricted area from which it seems to be rapidly disappearing. I know of no attempt to preserve this Western Australian remnant by placing some of the animals in a faunal sanctuary.

Genus 6.—MACROPUS (Shaw, 1790).

This Genus contains what may be termed the typical wallabies and kangaroos. The members are distinguished by possessing the following characters in common. The third upper incisor has an elongated cutting edge, it being usually the broadest tooth of the incisor series. The canines are in an extremely reduced condition and are lost very early. The bullae are not inflated. The tail is thick, and used as a fulcrum in slow progression; it is tapering towards the tip, evenly haired, and not terminated by a brush. The ears are elongated. Considerable attention is sometimes given to the direction of the hair upon the neck and body. This study of the hair trend forms an important subject in itself, but it is one of philosophic rather than of taxonomic importance, for it may be said that once the skin of an adult animal has passed through the hands of a taxidermist no deduction can safely be made concerning the hair trends of a well furred animal like a Kangaroo. The Genus is a very large one, and contains animals of rather varying characters and very varying size. As Oldfield Thomas has pointed out, the members of the Genus range in size "from that of a rabbit to that of a man." It is, therefore, convenient to divide this large assemblage of forms into rather smaller groups, and this classification has already been carried out in rather variable popular usage. Although the terms are not used throughout Australia with precisely the same connotation, we may accept Pademelons or Scrub wallabies, Brush wallabies, and Kangaroos as constituting three somewhat losely defined groups. These three groups correspond to the Small wallabies, Large wallabies, and Kangaroos as defined by Oldfield Thomas, or, better still, to the Sub-genera *Thylogale*, *Wallabia*, and *Macropus*.

We will, therefore, follow both popular and scientific usage and split the large Genus *Macropus* into three Sub-genera as follows:—

(A.) Size small. Pes less than 150 mm. in length. Basal length of skull less than 108 mm. Palatine vacuities large. Popularly known as Pademelons or Scrub Wallabies. Sub-genus 1. *Thylogale.*

(B.) Size medium. Pes from 160-250 mm. in length. Basal length of skull from 108-130 mm. Palatine vacuities medium. Popularly known as Brush Wallabies. Sub-genus 2. *Wallabia.*

(C.) Size large. Pes more than 260 mm. in length. Basal length of skull more than 135 mm. Palatine vacuities small. Popularly known as Kangaroos. Sub-genus 3. *Macropus* (*sens. strict.*).

Sub-Genus 1.—Thylogale (Gray, 1837).

Unfortunately the time has gone by when a good first-hand account of the small scrub wallabies inhabiting South Australia could have been written. The disappearance of the mainland wallabies is almost as remarkable a phenomenon as the disappearance of the Native Cat. So much has disappeared and so little has been preserved that it is now quite impossible to write dogmatically of the species which inhabited this State only a comparatively few years ago.

At the present time there is only precise evidence of the existence of a protean species which had a wide distribution upon the mainland and upon some of the islands lying off the coast; a second species, closely allied, confined to one island in the Bight, and a third which inhabited the South-East. It is likely that had more careful collecting been carried out and a sufficiency of material been preserved while there was yet time, evidence would have been acquired to show that in reality our small wallaby fauna was richer in species than we must now assume it to have been. The dominant species of scrub wallaby which at present is an inhabitant of South Australia has had many scientific names attached to it, and even now it cannot be affirmed with great conviction that the scientific name by which it is commonly known is the original and correct one for the species. Here we will orthodoxly term it *T. eugenii.*

Scrub Wallaby, Dama Wallaby or Pademelon.

Thylogale eugenii (Desmarest, 1817).

For want of mainland specimens the description here given applies to the form now living on Kangaroo Island.

Size fairly large. Form robust and sturdy. Coat thick and long, under-fur abundant and soft. General colour a dark, grizzled, grey-brown, becoming rufous upon the sides of the body and on the limbs. Face grizzled grey, slightly lighter on the cheeks than on the forehead, muzzle or margins of the upper jaw. Crown of the head slightly darker. Occiput with a darkening which extends between the ears backwards as a variably defined mid dorsal stripe. Hairs of the mid line of

the dorsal region 25 mm. in length, dark smoky-grey at the base, then with a narrow buff area, followed by a black or dark-brown tip. Interspersed with the underfur of the back are long piles, 45 mm. in length, and dark-brown or black in their whole extent. On the sides of the body the long piles become banded with buff, thereby producing the paler colouration of the flanks. Here also the black tips of the short hairs become replaced by rufous.

FIGURE 167.—Rhinarium of *Thylogale eugenii*.

Chin, throat, and ventral surface pale-buff with a slight and varying admixture of rufous, the hairs being smoke-grey at the base and buff at the tips. Inner aspect of the fore limbs pale rufous, outer aspect rather rich rufous. In younger specimens the rufous colouration extends dorsally over the scapular region and ventrally on to the chest. Manus clothed with short, grizzled, brown hairs. Hind limb buff, with admixture of rufous on its outer aspect. In some living specimens in certain lights a fairly distinct paler loin stripe is plainly marked. This loin stripe is, as a rule, not apparent on the prepared skin.

Pes clothed with short grizzled buff-brown hairs. Tail uniformly clothed on its dorsal surface with grizzled buff hairs, the dark tips of which become more conspicuous in the mid line towards extremity; on the ventral surface the hairs lack the black tip.

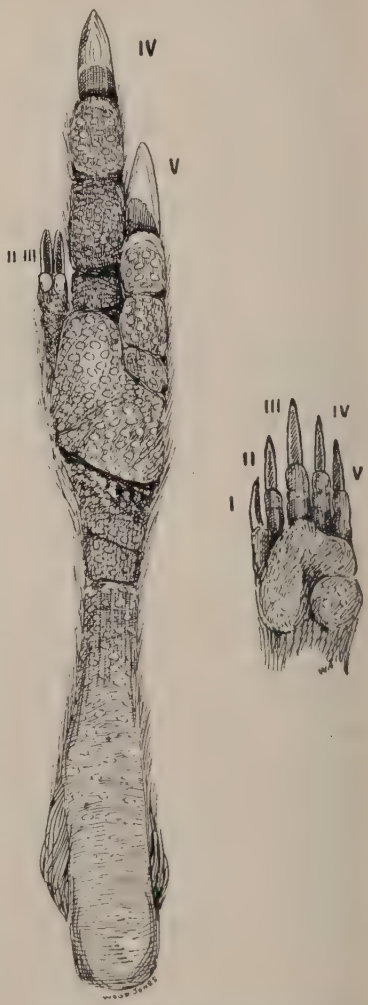

FIGURE 168.—*Thylogale eugenii*. Left manus and pes. Natural size.

Ears fairly long and pointed, somewhat darker than the head and face, clothed with grizzled brown hairs on the outer surface, and uniform buff hairs on the inner surface. Rhinarium naked over the area depicted in Figure 167.

The pupil is circular, the iris dark brown; abundant long black eyelashes spring from the upper eyelid; the lower lid giving origin to only a few, far shorter, hairs.

Facial vibrissae entirely black. Mysticials 30 mm., supraorbitals 35 mm., and genals 40 mm. in length. Submentals and interramals buff and inconspicuous. Manus and pes as in Figure 168.

The sexes differ but little. The males are distinguished by having more pointed heads and being generally paler in colour than females. They also exceed the females in size.

The skull is rather massively built and solid. It is readily distinguished from that of any other South Australian wallaby by the expanded posterior ends of the nasal bones, the outer margins of which are gently curved, and the square, parallel-sided interorbital portion of the skull. (*See* Figures 169 and 170.)

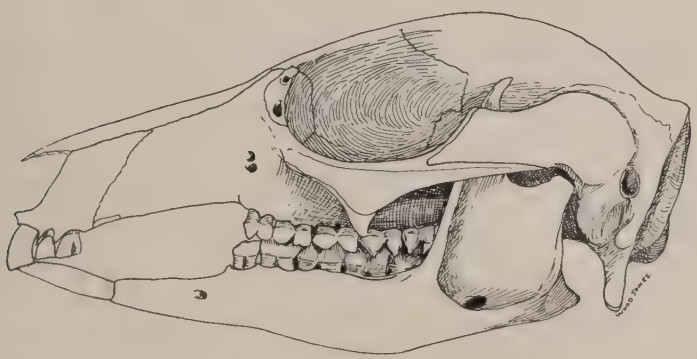

FIGURE 169.—*Thylogale eugenii*. Lateral aspect of skull of an adult male from Kangaroo Island. Natural size.

This description of the Kangaroo Island form differs from the classical descriptions and from mounted specimens of the mainland animal in the South Australian Museum in one or two rather noteworthy features. The typical mainland form is described as having the face uniform grey with, usually, an indistinct white cheek stripe. The manus and pes of the mainland form are said to be nearly black at their extremities. Neither of these features is marked in the insular form. Possibly the Kangaroo Island Wallaby deserves specific or sub-specific rank, but owing to the uncertainties of the nomenclature of the Dama Wallaby group the matter is one of unusual complexity.

DIMENSIONS of average full-grown Kangaroo Island males.

Head and body	♂ 710
Tail	" 510
Hind foot	" 140
Ear	" 60

Weight from 24lb. to 26lb.

This is considerably larger than the mainland form or the animal originally obtained on St. Peter Island and named *eugenii* by Desmarest.

DIMENSIONS OF SKULL.

	Average of Fifty Male Skulls from Kangaroo Island.	Average of Forty Female Skulls from Kangaroo Island.
Basal length	98·8	94·8
Breadth	54·5	52·8
Nasals, length	38·7	36·4
Nasals, breadth	19·2	18·9
Palate length	59·8	57·3
Interorbital constriction	17·1	17·1
Diastema	22·2	20·7
M^1—M^3	19	19

Of the mainland form the only skulls available for measurement are the following in the South Australian Museum :—

	No. 1748, Pt. Lincoln.	No. 1755, Tickera.	No. 1740, Pt. Lincoln.	♂ No. 1746, Pt. Lincoln.
Basal length	92	88	84	82
Breadth	50	50	48	50
Nasals, length	35	35	35	30
Nasals, breadth	18	16	16	16
Palate length	57	51	55	55
Interorbital constriction	16	16	14·5	17·5
Diastema	23	17	20	22
M^1—M^3	17	17	17	15

It is extremely difficult to define the former range of this complex species on the mainland of South Australia, or even to discriminate with any certainty between the mainland form and the type of animal now living on Kangaroo Island. Only a few years ago it swarmed in scrub-covered districts all over the State, to-day it seems impossible to secure a single mainland specimen for scientific study. In places where annual battues were held by the present landowners less than twenty years ago it has disappeared altogether. It is almost certain that some still linger upon the mainland, notably at the southern end of Eyre's Peninsula and in the South-eastern districts, but so far these animals have not been properly studied or preserved. The naturalist in South Australia is dependent upon Kangaroo Island for his material. In the island it breeds only once a year, and normally only one young is produced, it being an extremely rare phenomenon for two young to be found in the pouch.

In Kangaroo Island it is abundant and, since it lives in thousands upon Flinders Chase fauna reserve, it is guaranteed, in so far as complete protection can guarantee it, perpetual survival.

This animal has an interesting, and a somewhat involved, history. It was named *eugenii* because Péron and Lesueur captured what was presumably the type specimen upon L'ile Eugene, which was the name the French navigators gave to St. Peter Island in Nuyts' Archipelago. We must not lose sight of the fact that the original

animals came from St. Peter Island, and not from the mainland. Of the wallaby which lived on this island Flinders says that " at 2 o'clock Mr. Brown and his party returned from the eastern island bringing four kangaroos of a different species to any yet seen. Their size was not superior to that of a hare, and they were miserably thin and infected with insects."

Péron and Lesueur give us the following account :—" Le kanguroo existe en grand nombre sur L'ile Eugene, ou l'on peut en faire un chasse productive ; nous ne l'avons point vu sur le continent. Ce quadrupede parvient au poids de huit a dix livres (quatre a cinq kilogrammes) : sa fourure est epaisse son poil tres fin et d'une belle couleur rousse tirant sur le brun."

There is no need to discuss the confusion that has arisen out of the dual nomenclature of the island of origin of the species, nor is there need to dwell upon the many confusions that have arisen out of the designation " West Coast." To the South Australian, " West Coast " means the west coast of Eyre's Peninsula, to most zoological authors it has meant the west coast of Australia. These things are sources of very great confusion, and they are patent to any student who cares to look into the literature.

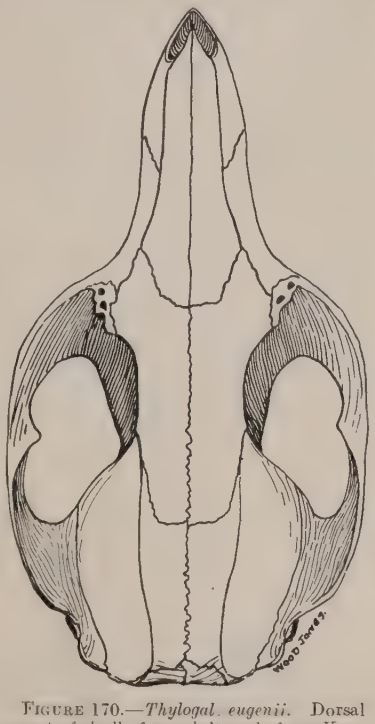

FIGURE 170.—*Thylogale eugenii*. Dorsal aspect of skull of an adult male from Kangaroo Island. Natural size.

The wallaby of St. Peter Island has become extinct, and therefore we cannot compare the animal now known as *Thylogale eugenii* with the St. Peter Island animal, and, moreover, the original specimen described by Desmarest is no longer in existence in Paris. It would seem to be somewhat doubtful if the animal now known as *Thylogale eugenii* is the same as the animal originally seen and captured on L'ile Eugene. The Kangaroo Island Wallaby is readily kept and bred in confinement, but it always evinces a shy and nervous disposition. When at rest it commonly sits with its tail thrust forwards between its hind legs. It has the habit—common among wallabies—of licking the arms when oppressed by the heat. In its wild state it moves about in a very silent manner when setting out upon its evening walk in search of food. It uses regular runs, which present the appearance of well-beaten highways leading through dense bush to the open glades in which it feeds. But although it threads its way through these runs in silence, the least cause of alarm will make a wallaby " thump," a sound produced by the striking of the earth with its hind feet. This thump is a warning note, and is produced by most gregarious wallabies and kangaroos.

(2) Flinders Island Wallaby.

THYLOGALE FLINDERSI (Wood Jones, 1924).

It seems evident that a mainland form of what we may term the Dama Wallaby group was widely spread over the southern portion of Australia. This mainland form, with its offshoots in widely separated localities, is represented by *T. dama* (Gould, 1844), and *T. gracilis* (Gould, 1844) in the west; by *T. derbianus* (Gray, 1837) in the south and west; by *T. thetidis* (Lesson, 1827) in the south and east; and by *T. parma* (Waterhouse, 1846) in the eastern portion of the continent.

As recognised insular offshoots from this stock are *T. houtmanni* (Gould, 1844), from the Abrolhos in the west; the lost *T. eugenii* (Desmarest, 1817), from St. Peter Island in the Great Australian Bight; and the Kangaroo Island form here referred to orthodoxly, but almost certainly incorrectly, as *T. eugenii*. To these representatives of the protean *dama* type must now be added another insular form, long known to be in existence but only recently examined critically.

This is a gracefully-built wallaby of a general grizzled silver-grey colour. It differs from the Kangaroo Island Wallaby in being more finely built and considerably less sturdy. The head is small in proportion to the body, and the whole animal elegant compared with the thick-set wallaby of Kangaroo Island. The coat has a texture altogether different in that it is fine, rather short and sleek, and lacks the woolly or fluffy appearance typical of the last species.

FIGURE 171.—Skulls of Flinders Island Wallaby (left) and Kangaroo Island Wallaby (right). The skulls are both of females and are of the same basal length. Natural size.

In general colour it is markedly grizzled light-grey, becoming strongly rufous over the shoulders in the male. The hairs of the mid dorsal region measure 20 mm., and the long entirely black hairs, which are so conspicuous in the last species, are entirely absent. The individual hairs are banded with white instead of buff, and the majority of them lack the dark tip.

The face is grey, with a well marked pale area extending along the upper lip to beneath the eye. Dorsal surface of the body pepper-and-salt grey. Sides and back of neck and shoulders rather bright rufous in the male, tawny in the female. Upon the occiput there starts a dark mid dorsal stripe; this stripe is very pronounced in the male and may be traced to the lower dorsal region. Chin and throat greyish-white; but the lower part of the neck, chest, and abdomen coloured almost as the dorsal surface, save that the pepper and salt mixture is somewhat lighter. Limbs pale fawn. Tail pale grey.

In the living animal the ears are pinkish-yellow within and but little hairy, without they are clothed by dark-grey hairs. Vibrissae, etc., as in the Kangaroo Island Wallaby.

The skull is lightly built and is at once distinguished from that of the last species by the narrow nasal bones, the outer margins of which are straight or nearly so, in contrast to the sinuous outer margins of these bones in the Kangaroo Island Wallaby. The average breadth of the nasal bones is 13·7 mm. in *flindersi*, as opposed to 19 mm. in the Kangaroo Island Wallaby. The constriction of the interorbital region is also considerably narrower than that typical of the latter animal. In *flindersi* the average minimum breadth of the interorbital constriction is 14·2 mm., as opposed to 17·1 mm. in the other species. (*See* Figure 171.) In the form of the nasal bones ***T. flindersi*** resembles ***T. billardieri***.

DIMENSIONS.

	♂ Type of Species.	♀
Head and body	570	510
Tail	410	340
Hind foot	132	118
Ear	47	50

DIMENSIONS OF SKULL.

	♂ Adult Type.	S.A. Mus., No. M.1751.	♀ Adult.	Adult.	Adult.	S.A. Mus., No. M.1750.	♂ Adult.	S.A. Mus., No. M.1749.	Adult. ♂
Basal length	95	92	88	87	85	85	84	84	79
Breadth	53	49	49	49	49	49	—	46	47
Nasals, length	38	36	34	34	34	32	—	34	33
Nasals, breadth	16	16	12	14	13	12		14	13
Interorbital breadth	14	14	13	14	14	15	14	15	15
Palate length	59	51	53	54	51	50	50	50	49
Diastema	20	19	17	19	19	19	17	17	19
M^1—M^3	18	17	18	16	18	16	18	15	15

This beautiful wallaby is confined to Flinders Island, one of the Investigator group of islands at the eastern end of the Great Australian Bight. At the present time it is restricted to a very small area of the island.

Flinders observed this animal in 1802, and he records that on the island "a small species of Kangaroo, not bigger than a cat, was rather numerous. I shot five of them, and some others were killed by the botanists and their attendants and found to be in tolerably good condition." Even comparatively recently the animal was very numerous, and it has been reported that as many as thirty thousand were killed on the island In 1910 a destructive bush fire swept the portion of the island occupied by the wallabies, and when I visited the place in 1920 no traces of it were to be found, and the tenant of the island believed it to be extinct. In 1922 I again visited the island and found obvious evidences of its presence, but no actual specimen was seen. In 1924 the little colony had considerably increased, and two specimens were secured for study purposes. The present small colony of wallabies occupies only a very limited area upon which the native bush has not been destroyed by various attempts at cultivation. Although the colony probably contains a hundred or so individuals its hold on life cannot be considered a very secure one. It is always at the mercy of bush fires, having no line of retreat, since it lives on a corner of the island that is girt by high and inaccessible cliffs. Moreover, it has to contend against two introduced animals, the feral domestic cat, which has overrun the island, and the food-destroying rabbit. It may at any time, though fortunately this does not seem to be at present the case, have to contend against human enemies. In January, 1924, the young were entirely independent of their mothers. On account of its build being rather more elegant than that of the thickset Kangaroo Island wallaby it was at one time a favourite with people who cared to have wallabies running in their grounds, but at present I believe there are no descendants of these animals living on the mainland. It has also been an inhabitant of the Zoological Gardens in Adelaide, but no specimens have been exhibited there for many years. A former tenant of the island has assured me that when the wallabies were numerous there were two distinct types living in the island, the one obviously that described as *Thylogale flindersi*, and the other a more rare, slender, yellow wallaby. What this second species was it is impossible to guess; there seem to be no traces of it left.

(3) **Rufous-bellied Wallaby.**

THYLOGALE BILLARDIERI (Desmarest, 1822).

In the collection of the British Museum there is a skull of this animal, formerly the property of Sir Richard Owen, which came from Mount Gambier. There are also two skeletons said to have been procured in South-east South Australia.

This small wallaby is distinguished by its short ears, stout form, and its long coat, which is dark-greyish-brown on the dorsal, and yellowish, or rufous, on the ventral surface. Face markings are absent, save for a faint pale-yellowish line which runs along the upper lip. The tail is very short, being only about two and a half times as long as the head, and only about half the length of the head and body. In the skull the nasal bones have straight outer edges, each bone being wedge-shaped.

DIMENSIONS.

	Tasmania. ♂ Stuffed. Brit. Mus.	Paris Mus.
Head and body	650	525
Tail	360	220
Hind foot	135	120
Ear	40	35

DIMENSIONS OF SKULL.

	Brit. Mus. ♂ Tasmania.	Brit. Mus. ♀ Islands of Bass Straits.
Basal length	99	95·5
Breadth	56	54
Nasals, length	39	36
Palate length	62·5	57·5
Diastema	24	22

This is the common small wallaby of Tasmania, it is present also in some of the islands of Bass's Straits and on the mainland of Victoria. Evidently it was at one time an inhabitant of the South-eastern portion of this State, where the Platypus and the Koala intruded into the South Australian fauna. If it still lingers in any corner of the South-East, I have been unable to ascertain. I know of no South Australian specimens, the Museum at Mount Gambier possessing no relic of the animal. It is a highly gregarious wallaby, and lives in Tasmania in large communities. Should a South Australian colony of the Rufous-bellied Wallaby still exist it is much to be desired that adequate protection be afforded to it.

Sub-Genus II.—Wallabia (Trouessart, 1905).

The larger wallabies contained in this section are characterised by possessing a pes which measures from 160-250 mm., and a skull the basal length of which is from 108-130 mm. As a group they constitute the most beautiful section of the large Genus *Macropus*, all of them being finely built and graceful animals, and many of them being rather distinctly, even brilliantly, marked and coloured. Seven or eight species are contained within the group; and it is a matter of the greatest difficulty to determine what species inhabit, or have inhabited, this State. After a great deal of inquiry (in the course of which 900 filled-in forms have been received from the scholars in various State schools) there is only definite evidence that two species are now living within the confines of this State, and of these species, one, the Toolach (*W. greyi*), is represented by less than half a dozen individuals. The other species, the Red-necked Wallaby (*W. rufogriseus*), inhabited South Australia in large numbers not long ago, but only a few are now living in the South-East. Of a third species, the Black-tailed Wallaby (*W. bicolor*), there are no records in the form of specimens or references in the literature; but on the evidence of reliable observers it is included here as a South Australian animal.

No elaborate table is required to separate these three species since their external characters are very distinct and obvious.

(A.) Coat colour grey fawn. Tail pale-grey with a white tip. Conspicuous face marks. 1. *W. greyi.*

(A^{1}.) Coat colour grey rufous, neck bright rufous. Tail grey, with a darker tip. Face markings inconspicuous. 2. *W. rufogriseus*

(A^{11}.) Coat colour dark rufous. Tail black. Face markings indistinct. 3. *W. bicolor.*

(1) Toolach Wallaby, Grey's Wallaby.

Wallabia greyi (Gray, Waterhouse, 1846).

Probably the most beautiful and elegant of all the wallabies, and very markedly distinct from every other form. Distinguished at once by its bold face markings, its banded hinder dorsal region, and its general grey fawn colouration. In general build it is light and elegant; in general colour a fine pale grey admixed with fawn. The coat is thick and rather woolly, the fur, especially over the lower portion of the back, having a somewhat crimped appearance. The face is boldly marked, a dark stripe running as a whisker mark from the muzzle to the lower border of the eye and beyond as a narrow tongue towards the ear. The muzzle, dorsal to the dark cheek stripe, is grey, changing to fawn on the crown of the head and at the base of the ears. Below the dark cheek stripe the upper lip is pale, almost white, the pale area extending past the eye and towards the ear, and then curving dorsally to form an almost white patch above the eye. The crown of the head, neck, and shoulders are delicate fawn. The ears are large and fawn coloured, both within and without. The region of the shoulder and upper part of the fore limb grey. Fore arm pale-fawn, the digits themselves being dark, almost black, in colour. The hind limb grey, with a not very well defined paler hip bar. The lower part of the hind limb pale-fawn, the digits being dark. The dorsal surface of the body fawn as far as the shoulders, and from there caudad, becoming more distinctly grey. From a point somewhat in front of the costal margin to the root of the tail the back is distinctly banded (though the bands are not equally conspicuous in all lights) with alternate bars of lighter and darker grey. These bars are marked not only by their colour, but by the texture of the fur, and as a rule some ten or twelve bands may be detected. The ventral surface is pale fawn, this colour extending to the front of the hip, anterior to the pale hip bar. The tail is pale grey, and it becomes distinctly paler towards its tip.

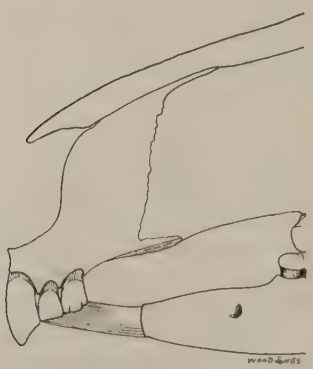

Figure 172.—Anterior part of skull showing incisor teeth of *Wallabia greyi*. Natural size. Specimen S.A. Mus., M. 1762.

The skull cannot be confused with that of any other wallaby when regard is paid to its general form and its remarkably small second and third incisor teeth. (*See* Figure 172.) The brain case is small, and relatively the nasal portion of the skull is excessively large. The nasal bones are broad and much expanded behind. The interorbital region is very broad, parallel sided, and with sharply angulated margins. All the teeth, with the exception of the first upper incisor, are extremely small; the second and third incisors are minute when comparison is made with the skull of any other wallaby which attains anything like the same general size.

DIMENSIONS.

The measurements are of mounted animals in the British Museum.

	♂	♀
Head and body	810	840
Tail	730	710
Hind foot	212	216
Ear	65	71

DIMENSIONS OF SKULL.

	♂ No. 1762, S.A. Mus.	♀ Brit. Mus.	♂ Brit. Mus.	No. 1761, S.A. Mus.	No. 1760. S.A. Mus.
Basal length	118	114	111	110	110
Breadth	59	64	63	58	59
Nasals, length	57	57	55	52	50
Palate length	75	75	74	69	68
Diastema	33	35	33	31	30
Length of I^3	4·5	—	4·4	4	4·5

The Toolach has always been confined to the South-eastern portion of South Australia. Since the animal is such a very distinct one, and an inhabitant of open country, it has for very many years been particularly well known, and many people can remember the time when Toolaches swarmed in the neighbourhood of Kingston. Being by far the fleetest of all the wallabies, its chase was at one time a very popular form of sport, and its beautiful pelts have been marketed in very large numbers in the salerooms of Melbourne. Its mode of progression, as well as its distinctive face markings, rendered it easy to recognise, since it had the peculiarity of taking two short hops and one long one. It is not correct to say that this very fine and distinctly South Australian wallaby is extinct, for at the present moment five or six individuals still exist. Any effort to preserve this remnant must be made immediately and with vigour if it is to be of any service whatever.

(2) **Red-necked Wallaby.**

WALLABIA RUFOGRISEUS (Desmarest, 1817).

This is the animal usually described as *Macropus ruficollis* (Desmarest, 1817), or as *M. ruficollis var. typicus*. The name *ruficollis* was given by Desmarest to animals from King Island, and *rufogriseus* to mainland specimens; and this latter name is therefore retained. Besides the King Island and the mainland forms,

there is another variety, the common large wallaby (often termed kangaroo) of Tasmania, which is known as *bennetti* (Waterhouse, 1837).

As far as South Australia is concerned the material available for study is represented in the State Museum by a single skull (No. M. 1758) from Mount Gambier. For the external characters, therefore, previously published accounts of the mainland form are drawn on.

Size large, the animal being the largest member of the Sub-genus. Form slender and graceful. General colour greyish fawn, becoming bright rufous on the back of the neck and over the hind quarters, the centre of the dorsal region being more distinctly grey. Some specimens show an indistinct paler hip bar. The face markings inconspicuous, dorsal surface of muzzle dark brown, connecting two lateral darkish cheek stripes, below which are paler areas bordering the upper lip and ending just below the eye. Crown of the head rufous grey. Ears long, their backs rufous, becoming darker towards the tips. Manus and pes grey, darkening almost to black over the digits. Chin, chest, and ventral surface of the body greyish white or white. Tail grey above and paler below, the tip being dark brown or black. The skull has a large brain case and a comparatively short nasal region. Nasal bones short, and ending some distance from the front of the premaxillae. (*See* Figure 173.) Incisor teeth large and powerful; I^3 large, with a strongly marked notch at the centre of its cutting edge. (*See* Figure 173.)

FIGURE 173.—Anterior part of skull showing incisor teeth of *Wallabia rufogriseus*. Natural size. Specimen S.A. Mus., M. 1758.

DIMENSIONS.

	Stuffed. Brit. Mus. ♂ New South Wales.	Stuffed. Brit. Mus. ♀ New South Wales.
Head and body	1.050	925
Tail	750	700
Hind foot	230	220
Ear	78	76

DIMENSIONS OF SKULL.

	Brit. Mus. Mount Gambier.	S.A. Mus. Mount Gambier.
Basal length	122	120
Breadth	64·5	62
Nasals, length	54	45
Palate length	80	73
Diastema	34	26
Length of I^3	8·6	8·5

Apparently this animal was extremely abundant in the South-East only a few years ago; but to-day its numbers are reduced to no more than a few stray individuals. In the British Museum Catalogue of 1888 four skulls in the collection are recorded as being from Mount Gambier; and in the South Australian Museum there is a single skull from Mount Gambier. *W. rufogriseus* is a southern form, and its range stretches through southern New South Wales and Victoria into South Australia, and from the mainland into the islands of Bass's Straits and into Tasmania.

(3) Black-tailed Wallaby.

WALLABIA BICOLOR (Desmarest, 1803).

This is a heavy, dark coloured wallaby, generally known as *Macropus ualabatus* (Lesson & Garnot, 1826), or as *M. ualabatus var. typicus*. Since there appears to be no doubt that Desmarest's name applied to this animal, it is here adopted in preference to the later name given by Lesson and Garnot. No South Australian specimens are preserved so far as I am aware, and therefore the description here given is derived from previously published accounts.

General form thickset and robust. Fur long, thick, and coarse; coat almost shaggy in texture. General colour dark rufous grey, the hinder part of the body being more rufous than the fore part. The patch of hair around the base of the ears, the chin, and chest, and ventral surface of the body pale rufous or yellowish. Face markings inconspicuous. Ears short, coloured like the head. Fore limbs and sides of body grizzled dark grey. Manus and pes brown, digits black. Tail black, sometimes grizzled towards its root.

DIMENSIONS.

	New South Wales. ♂ Skin. Brit. Mus.	New South Wales. ♀ Stuffed. Brit. Mus.
Head and body	820	815
Tail	650	650
Hind foot	208	187
Ear	59	63

DIMENSIONS OF SKULL.

	New South Wales. ♂ Brit. Mus.	Victoria. ♀ Brit. Mus.
Basal length	127	110
Breadth	68	65
Nasals, length	57	47
Palate length	81	69
Diastema	30	22·5
Length of I^3	8	—

I know no specimen obtained in South Australia, and include a brief description of the species solely because observers who know the animal in Victoria

have informed me that it occurs in certain parts of the South-East. This occurrence is likely, and probably this species inhabited, or inhabits, that tract of country (South Australian in political boundary, but Victorian in faunal likeness) in which the Rufous-bellied Wallaby, the Koala, and the Platypus have been found.

Sub-Genus 3.—Macropus (*sens. strict.*).

The animals contained in this Genus are the big bulky creatures known as Kanroos, Wallaroos, and Euros. They are banded together mainly on account of their size, and owing to the fact that the group has been studied from isolated specimens in European Museums rather than in the mass in Australia, the question of their species and varieties has become an extremely involved one. Looking at the restricted Genus *Macropus* from the broad point of view of adaptation and environment it may be said that three types are contained within it. (1) The type of animal which lives in high rock-strewn ranges ; this type is here termed the *robustus* type. (2) The type which lives in open plains ; this type is here termed the *rufus* type ; and (3) the type which lives in country characterised by dense scrub and open glades ; this type is here termed the *giganteus* type. Since the environments of rocky ranges, open plains, and scrub lands are widely represented in all Australian topography, each type of animal possesses a very wide geographical range. As is usually the case in widely ranging types, considerable variation is displayed in individuals representative of the scattered districts of their habitat. Moreover age, sex, district, and season are all factors which exert a considerable influence upon the pelage of the animal. To examine a few skins in a museum is an experience altogether different from visiting a warehouse where skins lie exposed during the skin sales. There are varieties unending of Euros, Reds, and Greys, and moreover many of these varieties will be present in one parcel of skins collected in a fairly restricted area. Here, then, we will be somewhat conservative of scientific names and recognise three main types, and of one of the types two species so far as South Australia is concerned, a continental species, and an insular species. Again, it must be emphasized that though the recognition of "euros," "reds," and "greys" may not be always easy from an examination of the mere dried pelt, there is never any doubt as to what species any kangaroo belongs if only one glance may be had at the tip of its nose. The euro has a large naked black end to its nose, very much after the fashion of a dog. The red kangaroo has its nostrils ringed with naked black skin and separated from each other in the middle line by naked black skin. The grey kangaroo, and the Kangaroo Island kangaroo have the nostrils narrowly ringed with naked black skin, but the tip of the nose between the nostrils is soft and hairy. Apart from these external characters, the features of the skull at once separate the three types with the utmost certainty, the skulls being so easy to differentiate by obvious characters that every blackfellow and most white men with a good knowledge of outback life can readily tell them apart. It must always be remembered, however, that cranial characters can only be determined from the examination of a large number of skulls, and in many cases species have been established upon the evidence of an individual or a few individuals. Such species as *M. antilopinus* (Gould, 1841), *M. bernardus* (Rothschild, 1904), *M. hagenbecki* (Rothschild, 1907), *M. isabellinus* (Gould, 1841), *M. magnus* (Owen, 1874), and the many sub-species mentioned later need the examination of far more material to

establish their specific or sub-specific validity. The cranial characters defined here are all determined from the examination of large numbers of crania. Cranial features which are very apparent are not always those which are most readily tabulated, and these will be separately mentioned or figured. Meanwhile the following table will serve to distinguish the South Australian species of the Genus.

External characters.—

(A.) Fur coarse and straight. Coat hairy and not woolly. Rhinarium entirely naked. 1. *M. robustus.*

(A^1.) Fur soft and woolly. Rhinarium only partly naked.

(B.) Rhinarium naked between the nostrils. Face markings present. 2. *M. rufus.*

(B^1.) Rhinarium hairy between the nostrils. Face markings absent.

(C.) Colour greyish-brown. Muzzle, digits, and distal half of tail brown. 3. *M. giganteus.*

(C^1.) Colour sooty-brown. Muzzle, digits, and distal half of tail black. 4. *M. fuliginosus*

Cranial characters.—

(A.) Length of nasals but little more than twice the maximum depth of the zygoma. Muzzle region with almost parallel sides. 1. *M. robustus.*

(A^1.) Length of nasals three times, or more, the depth of the zygoma. Muzzle region tapering towards the tip.

(B.) Anterior palatine foramina at mid point, or anterior to mid point, of incisive canals. I^3 with one inconspicuous external notch, considerably shorter than I^1 and I^2 combined. 2. *M. rufus.*

(B^1.) Anterior palatine foramina altogether behind the incisive canals. I^3 with two external notches, equal to or slightly shorter than I^1 and I^2 combined. 3. *M. giganteus.*

(B^{11}.) Anterior palatine foramina at posterior ends of incisive canals. I^3 with two or three external notches, equal to or longer than I^1 and I^2 combined. 4. *M. fuliginosus.*

(For details of the anterior palatine foramina, *see* Figure 174).

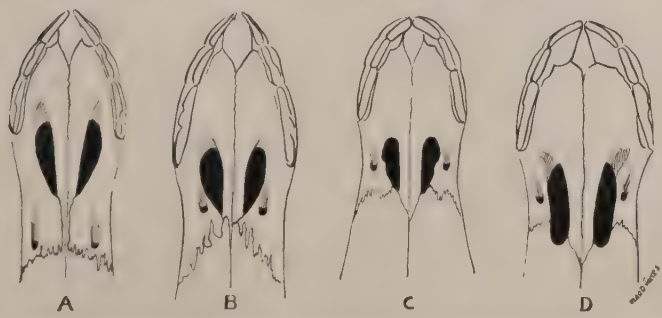

FIGURE 174. The anterior end of the palate, with the incisor teeth of the four large kangaroos. Natural size. A. *Macropus giganteus.* B. *Macropus fuliginosus.* C. *Macropus robustus.* D. *Macropus rufus.*

(1) Euro : known in the Eastern States as Wallaroo.

MACROPUS ROBUSTUS (Gould, 1840).

This is the sturdily built, hairy coated, kangaroo of the ranges. The texture of the coat, the comparatively short and enormously strong limbs, and the naked black nose at once distinguish animals of the *robustus* type from any other of the large kangaroos. (*See* Figure 175.) When coat colour is taken into consideration, and variable and unessential characters are given undue prominence, a vast number of varieties or sub-species may be distinguished. In order to save the reader from confusion a list of the named varieties is appended.

(1) *M. alexandriae.* (Schwarz, 1910.)
(2) *M. alligatoris.* (Thomas, 1904.)
(3) *M. argentatus.* (Rothschild, 1905.)
(4) *M. bracteator.* (Thomas, 1911.)
(5) *M. cervinus.* (Thomas, 1900.)
(6) *M. erubescens.* (Sclater, 1870.)
(7) *M. isabellinus.* (Gould, 1841.)
(8) *M. reginae.* (Schwarz, 1910.)
(9) *M. rubens.* (Schwarz, 1910.)
(10) *M. woodwardi.* (Thomas, 1901.)

All these names are, or have been, applied to races or varieties of this species, and it is quite possible that this list does not exhaust the synonyms that have been bestowed upon the type *M. robustus.*

FIGURE 175.—Rhinarium of *Macropus robustus.*

The following is the description of what may be termed a typical South Australian animal. Size large, form stout and heavy and, if seen in an unwonted environment, apparently clumsy. Fur thick and coarse, and distinctly hairy as opposed to woolly. Under-fur thin and sparse. General colour a rather brilliant admixture of smoky blue and fox red. Face grizzled dark grey, cheeks darker than the region below and behind the eye. Margin of the upper lip pale grey. Shoulders rather bright rufous. The elbow with a dusky patch, which runs forwards along the side of the neck and separates the rufous dorsal from the dusky white ventral surface. General colour of dorsal surface changing from rufous over the occiput, neck, and shoulders, to smoky blue over the hind quarters. Ventral surface pale, grey white over throat and chest, smoky grey over lower costal region and upper part of abdomen, and grey white over lower portion of abdomen. Hairs around base of ears distinctly paler than general colour of face and head. Ears large and oval in outline, dark without and pale rufous within. Fore limbs, from the elbow downwards,

paler than general body colour; above the elbow they are dark. Manus dark grizzle. Digits themselves dark, almost black, in colour. Hind limbs paler than general body colour, often with an indication of a paler hip bar. Digits of pes dark, almost black. Eyelashes and vibrissae black. Young specimens are more markedly rufous than adults and old animals. Tail relatively short and extremely thick; dusky rufous in colour.

The skull of *robustus* is easily distinguished from that of any other kangaroo. It is characterised by being sturdily built and massive. The muzzle region is distinguished by the short, broad, nasal bones, and the lateral inflation of the whole of the snout. This lateral inflation causes the muzzle to taper very little towards its tip, and in this character the skull differs markedly from that of *M. rufus* and *M. giganteus*. This lateral swelling of the muzzle is more marked in old examples than in young ones. In fully adult males the muzzle region is commonly broadest anterior to its mid point; and the condition of the snout region which is described as differentiating the Antilopine Kangaroo (*M. antilopinus*) cannot be said to be one unmatched in the skulls of *M. robustus*. The zygoma of *robustus* is remarkably deep from above downwards, and this feature constitutes an outstanding characteristic of the skull at any age. (*See* Figure 176.) The foramen magnum is small when compared with that of other species, and this character is mentioned since it is the one by which kangaroo hunters can invariably tell the skull of *robustus* from that of *rufus*. Again, compared with *rufus*, the posterior narial apertures are particularly small. (*See* Figure 179.)

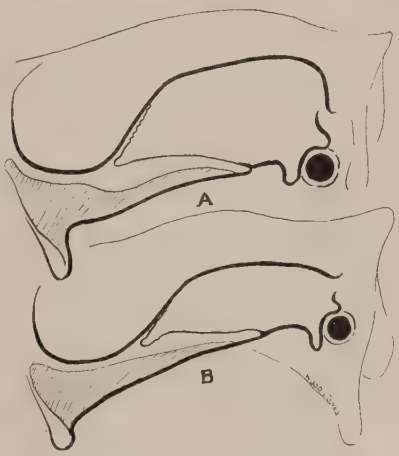

FIGURE 176.—Portion of the left side of the skulls of A. *Macropus robustus* and B. *Macropus rufus*. The figure shows the zygoma of each skull in order to illustrate the very characteristic form of this bar of bone in the two species. Half natural size.

The incisive canals are subject to some considerable variation, and no very hard and fast rules can be laid down. We may say that they vary in length from 8 mm. to 20 mm., and that they may or may not invade the maxillae.

The anterior palatine foramina open at some point along the length of the incisive canals, but their relative position naturally varies with the degree of posterior extension of the canals. (*See* Figure 174.)

The many other points of cranial architecture which are usually given as typical of the skull of *robustus* are unreliable. No other criteria than those already mentioned hold good when large series of skulls of the large kangaroos are examined. Nevertheless, though the points of absolute distinction here given are few, they are so constant that there cannot be the least doubt in determining the skull of *robustus* and in distinguishing it from any other well established species. In addition to this, one dental character separates *robustus* from all the other large kangaroos.

The incisor teeth are simple and their enamel-covered area is very short from above downwards. These stumpy incisors with their short enamel surfaces are diagnostic of *robustus* and, in general, it may be said that the second incisor tooth has the enamel-covered portion about as long as broad, and the third incisor shows an enamel area twice as broad as it is long. (*See* Figure 177.)

AVERAGE DIMENSIONS OF ADULT MALES.

Head and body	c. 1,300
Tail	900
Hind foot	310
Ear	95

DIMENSIONS OF SKULL.

The following measurements are of a series of nine adult skulls from Bimbowrie :—

	No. 15.	No. 1.	No. 8.	No. 11.	No. 3.	No. 7.	No. 2.	No. 10.	No. 14.
Basal length...	182	182	177	176	175	174	172	172	170
Breadth	100	96	97	95	95	100	92	92	92
Nasals, length	74	75	66	74	77	76	68	72	67
Palate length	117	117	115	112	115	115	111	110	109
Width of zygoma	33	28	29	29	28	33	29	28	25
Breadth of I^3	7·5	7·5	7·5	7·5	8	7	—	8	8

The Euro is not by any means an abundant animal in South Australia. From most of the ranges nearer the more settled areas it has either been exterminated, or has been greatly reduced in numbers. Nevertheless the remnant will probably survive for long, since the animal inhabits the most inaccessible and the least desirable tracts in South Australia. It is only the kangaroo shooter who earns a living, or adds to his income, by obtaining pelts who is a real threat to the survival of this animal. But for him it might remain for ever in its rock-strewn ranges, where it does no damage either to the agriculturalist or the grazier. From the rejecta of the kangaroo shooter Mr. Coulston, of Bimbowrie, has rescued a series of forty- two perfect skulls for study purposes; and this is an example which it is much to be hoped will be imitated by others having like opportunities. All over Australia kangaroo skulls may be found at the camp sites of the men who have flayed the animals for their pelts. It is high time these skulls were collected and preserved, for the material at present stored in our museums is quite inadequate for the proper study of the cranial characteristics and the range of variation of any species.

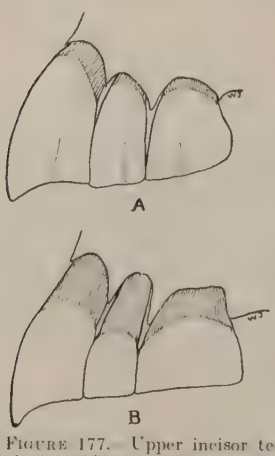

FIGURE 177. Upper incisor teeth of the left side of A. *Macropus rufus* and B. *Macropus robustus*. The skulls are of the same length and the animals the same age. Twice natural size.

The Euro lives as a rule in small communities, since its food is usually not abundant in the habitat of its election. Its station is probably determined mostly

by the proximity of some rock hole where water is to be obtained. It is a sturdy, stubborn creature, which will put up a determined fight, and which does not adapt itself so readily to captivity as do the other large kangaroos. In its wild state it is far more cunning than the other kangaroos, and when alarmed is an adept at seeking cover. When startled it has the habit of going straight ahead for safety, and not stopping till it is well out of sight. In this it differs from the other species which usually stop after a short flight and take a look at the object which has startled them.

(2) Red Kangaroo, female known as Blue Doe or Flying Doe.

MACROPUS RUFUS (Desmarest, 1822).

The Red Kangaroo is the large, gracefully built kangaroo of the plains and table lands, which ranges, in such country, practically from one side of Australia to the other, its territory being more restricted on the west than on the east.

FIGURE 178.—Rhinarium of *Macropus rufus*.

The colour and texture of the coat, and the nature of the face markings, and the characters of the rhinarium at once distinguish it. Nevertheless, a variety of names is applied to the *rufus* type, either as the distinctions of local races or of mere individual, seasonal, age, or sex variations. Of these names we may enumerate the following :—

(1) *M. occidentalis.* (Cohn, 1906.)
(2) *M. magnus.* (Rothschild, 1907.)
(3) *M. pallidus.* (Schwarz, 1910.)
(4) *M. laniger.* (Gaimard, 1823.)
(5) *M. griseo-lanosus.* (Quoy and Gaimard, 1825.)
(6) *M. lanigerus.* (Gray, 1827.)
(7) *M. pictus.* (Gould, 1860.)
(8) *M. ruber.* (Crisp, 1862.)
(9) Probably *M. magnus.* (Owen, 1874.)
(10) *M. dissimulatus.* (Rothschild, 1905.)

The following description applies to typical South Australian specimens. Size large, form slender and graceful, limbs slender ; the animal being much more finely built than *M. robustus*. Fur short, close, and soft, there being no long hairs in the texture of the coat. On most parts of the body the coat can be brushed in either direction, there being no very decided slope to the hairs.

The head is characterised by its large bow nose, terminating in a characteristic naked rhinarium, which is very sharply delimited. (*See* Figure 178.) The texture

of the skin of the rhinarium is coarsely granulated and in colour it is dusky, but not shiny, black.

The general colour of the adult male is bright rust red. Face grey, with a well marked black whisker mark, below which is a white area bordering the upper lip. Head, shoulders, and the whole of the dorsal surface of the body, bright rusty red, turning to grey on the sides and to white on the ventral surface. In some specimens the rufous colour invades the ventral surface below the costal margin. Limbs pale, rufous at shoulder and hip, cream coloured at ankle and wrist, digits dusky. Tail rufous above and pale beneath. Ears long, clothed with rufous hairs without and with pale fawn hairs within. Iris dark-brown; black eyelashes abundant. Facial vibrissae black.

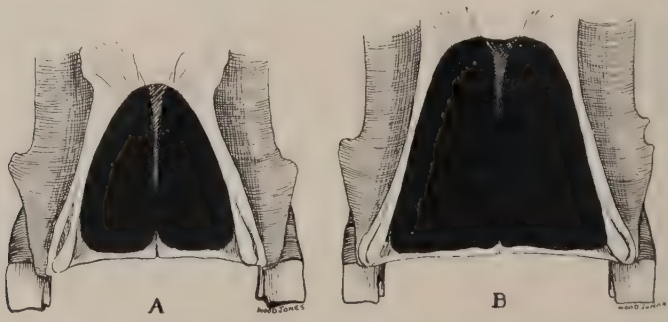

FIGURE 179.—The back end of the nasal chambers of A. *Macropus robustus* and B. *Macropus rufus*. The skull is viewed from its hind end, and the drawing includes the last molar teeth, seen at the sides of the base of the figures. Natural size.

The female, when adult, is a beautiful smoky blue in those parts where the male shows the bright rufous colouration. Young animals of both sexes show a rather strange admixture of smoke blue and rufous, the individual hairs being pale rust colour at the roots and smoky-blue at the tips. The brilliant colouration of the living animal fades rather remarkably in the dried skin.

The skull of *rufus* is readily distinguished. It is not so stoutly built as that of the *robustus* type, and its most outstanding feature is the great size of the nasal chambers. This character is made apparent in the enormous size of the posterior openings of the nasal chambers and in the great width of the back end of the palate behind the molar teeth. (*See* Figure 179.) From *robustus* it is distinguished by its relatively narrow zygoma (*see* Figure 176) and by the long enamel area of the simple third incisor tooth (*see* Figure 177), whilst the simplicity and small size of this tooth at once distinguishes it from *giganteus*, from which it is also distinguished by the site of the naso-palatine foramina. (*See* Figure 174.)

AVERAGE DIMENSIONS OF ADULT MALES.

Head and body	♂ 1,600
Tail	1,000
Hind foot	350
Ear	110

DIMENSIONS OF SKULL.

The following measurements are of a series of nine adult skulls from Bimbowrie :—

	No. 15.	No. 17.	No. 19.	No. 14.	Aged. No. 18.	No. 24.	Aged. No. 16.	No. 20.	Aged. No. 13.
Basal length	204	201	200	199	198	198	197	176	171
Breadth	103	100	98	97	99	98	101	89	85
Nasals, length	79	89	86	73	91	84	78	73	70
Palate length	127	125	125	124	125	123	124	113	110
Width of zygoma .	23	24	23	22	23	22	23	20	16
Breadth of I^3	7	7	7	9	5	9	—	6	5

Although the Red Kangaroo has a wide range in South Australia, it cannot be considered as a common animal. Its movements are, at the present day, so restricted by fences that its temporary abundance in any one locality cannot be taken as an index of the numbers of the animal still living. Its greatest enemies are drought and mankind. Fences act adversely on its free migrations, which in past times enabled it to escape from drought-stricken areas and seek country where green food was still to be had.

From droughts it now has little chance of escape ; from man, under modern conditions, it has still less. In the old days when it was hunted by dogs and ridden down on horseback, its fleetness would often prove its safeguard ; to-day, when the thoroughly unsportsmanlike method of employing motor cars in the chase is adopted, its chance of escaping a rifle bullet is very small indeed. Though very fast, it is a somewhat foolish animal, and its habit of going off at top speed and then stopping, whilst it looks around at the source of danger, is a fatal one. Practised kangaroo shooters, who obtain pelts for the market, account for vast numbers every year, and there is no doubt that the demands of the leather and fur trades, the practice of the so-called sport of shooting from motor cars, and especially the cutting up of large unfenced holdings into smaller fenced ones, is threatening the continued existence of Australia's finest kangaroo.

The Red Kangaroo is a fine, plucky, animal, which is always ready to defend itself at close quarters. In captivity it does well, and often exhibits a truculent familiarity which, on the part of a large male, is apt to be embarrassing or even dangerous. It breeds only once in the year, the single offspring running with the mother as a rule in January.

(3) Grey Kangaroo. Scrub Kangaroo.

Macropus giganteus (Zimmermann, 1777).

The Grey Kangaroo is the large, graceful, woolly-coated kangaroo of the scrub lands and bush country. Its hairy nose (*see* Figure 180) and its long, soft, grey-brown fur at once distinguish it from *robustus* or *rufus*.

The fur is soft and woolly, and has in general a roughed-up appearance owing to the varying nature of the hair trend in different parts of the body.

The typical South Australian animal is dusky grey brown over the head, dorsal surface of the body, and tail, and light-grey or almost white on the ventral surface. The muzzle and face are dusky brown, the crown of the head and cheeks rather

more rufous. The backs of the ears are clothed with grizzled grey-black hairs, each hair being banded with white and dark brown. The inner surface of the ears clothed with light-grey or almost white hairs. Outer side of fore limbs grizzled brown, inner side almost white. Manus, wrist, and fore arms clothed with short grizzled fawn hairs, the digits themselves being dusky. Hind limb pale fawn, becoming grizzled over the base of the digits and dusky brown over the tips. Nails uniform brown black. Tail brown, darkening towards the tip, which is dark brown, in some specimens almost black.

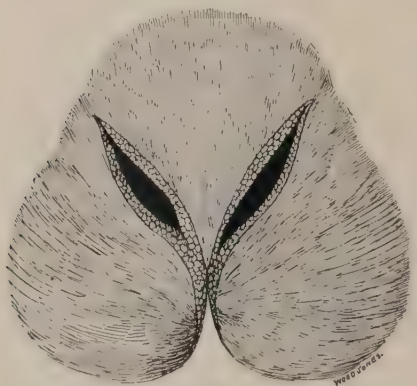

FIGURE 180.—Rhinarium of *Macropus giganteus*.

The tip of the nose between the nostrils is clothed with fine brown hairs, only the margins of the nostrils themselves being ringed with naked black skin. (*See* Figure 180.)

The iris is very dark brown. The eyelashes are long and black. All facial vibrissae well developed and black in colour.

The female is coloured like the male, but is, as a rule, much smaller.

The skull is easily distinguished from that of either *robustus* or *rufus* by the characters of possessing small posterior openings of the nasal chambers, combined with a comparatively narrow zygoma and naso-palatine foramina situated behind the incisive canals. (*See* Figure 174.) From these two forms it is also readily distinguished by the large size of its doubly grooved third incisor tooth. (*See* Fig. 182.)

AVERAGE DIMENSIONS OF ADULT MALES.

Head and body	♂ 1,500
Tail	925
Hind foot	330
Ear	100

DIMENSIONS OF SKULL.

	South Australian Museum Specimens—Adult Males.				Series of Young Adult and Young South Australian Skulls.						
	No. 1871.	No. 1975.	No. 1873.	No. 1874.	G 4.	G 5.	G 3.	♂ G 6.	♀ G 2.	♀ G 7.	♂ G 1.
Basal length	198	193	192	181	177	177	174	172	153	150	112
Breadth	94	98	95	93	89	89	85	89	82	76	65
Nasals, length	73	82	78	73	71	76	74	70	67	60	44
Palate length	130	128	125	120	116	114	113	113	100	96	70
Diastema	59	60	59	55	57	55	56	51	47	44	27
Length of I^3	10	9	10	9	11	—	—	11	11	10	10
Width of back of lower jaw	83	—	90	—	88	87	81	85	77	74	59

Grey Kangaroos which live in the more inland and less fertile portions of the State are, as a rule, smaller, more lightly built, and darker in colour than those which inhabit the timbered districts near the coast. These small, dark, animals are known as Black-faced Kangaroos—*Macropus melanops* (Gould, 1842)— or as *M. giganteus var. melanops*, but their claim to rank as a distinct species appears to be rather slender.

Although the Grey Kangaroo still exists in considerable numbers in suitable country, it seems likely that it is in greater danger of extermination than either the Red Kangaroo or the Euro. This is partly for the reason that it is not such a hardy or resourceful animal as the other large kangaroos, and partly because it inhabits better country, where it is sooner brought into opposition with the settler.

It is a shy, but rather stupid and inquisitive animal, which stands urgently in need of protection. In captivity it is gentle, but nervous ; and it readily looses its head if alarmed. It is extremely docile, being far more gentle than *rufus* and far more tractable than *robusta*. It has a curious habit of shivering the skin over the whole of its body when apprehensive, and when suddenly alarmed it becomes so unreasoning that it will hurl itself into fences regardless of the consequences to itself. It breeds only once in the year, and only one young is produced at a time. The young is usually running with its mother towards the end of December.

(4) **Sooty Kangaroo. Kangaroo Island Kangaroo.**

MACROPUS FULIGINOSUS (Desmarest, 1817).

This is the large, dark, scrub-haunting kangaroo which inhabits Kangaroo Island. The animal was originally described by Desmarest, and an extended description of the species, written from recently collected material, is as follows :-

Size large, the adult males being considerably larger and more heavily built than even the largest specimens of *M. giganteus*. Form robust, even clumsy, the old males appearing as almost gigantic lumbering creatures. The general colour is a dull, dark, sombre brown, the general colouration being considerably darker than that typical of *M. giganteus*. The fur is devoid of sheen, and the appearance might be described as dusty. The mid dorsal line is considerably darker than the sides of the body. The individual hairs of the mid dorsal region averages 25 mm. in length ; they are dark smoky brown at the base and lighter at the tips. At the sides of the body the hairs reach a length of 55 mm. and each hair is dull smoky brown at the base and pale dull brown at the tip. The hairs of the mid dorsal region are straight : those at the sides of the body are crenated, and give the coat a shaggy appearance.

The shoulders and the costal region are somewhat paler than the region of the sides of the abdomen and loin. The ventral surface of the body is clothed with hair upwards of 40 mm. in length, dark smoky brown at the base, and white, dirty white, or pale brown at the tips. The crown of the head as far forwards as the middle of the eye, is dark brown, being darkest in the middle line. The cheeks somewhat lighter. From the middle of the eye to the extremity of the rhinarium the colour becomes increasingly dark, the muzzle itself being nearly black. The chin is dark, the colour becoming paler further back so that the throat becomes increasingly white by the admixture of pale tipped hairs. Outer side of the limbs

dark brown, conspicuously grizzled with white-tipped hairs. Inner side pale brown. A dark patch is rather conspicuous over the region of the elbow. Lower part of forearm increasingly dark in colour, the white-tipped hairs ceasing about the middle of the forearm. Wrist and manus black.

Hind limbs dull-brown. Pes clothed with short hairs, which become paler at the margins of the soles. From the base of the digits, onwards to the tips, the light-brown hairs give way to dark brown and finally to black, the large fourth digit being entirely black.

The tail is enormously thick and relatively short, its great girth being maintained for the greater part of its length. On the dorsal surface the base of the tail clothed with dark-brown body hairs; this soon gives place to short, closely adpressed brown hairs, which become increasingly dark as they are traced distally. The terminal half, or more, of the dorsal surface and sides of the tail clothed with glossy, closely adpressed black hairs. The ventral surface of the tail has what almost amounts to a ventral crest of coarse, harsh, longish hairs of a dirty yellowish brown colour. The ears are clothed with short dark-brown hairs externally, and with

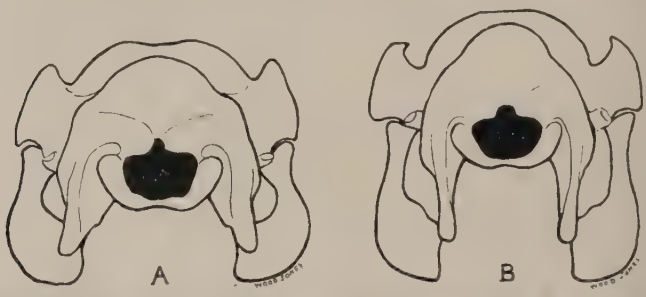

FIGURE 181.—Hind end of the skull of A. *M. fuliginosus* and B. *M. giganteus* to show the difference in form. Both the skulls are of the same basal length. Half natural size.

whitish hairs internally. The rhinarium is hairy to the tip, only a narrow margin of black naked skin surrounding the nostrils. The eyelashes are present on both lids, and are black in colour. The facial vibrissae are sparse and black, none of them measuring more than 60 mm. The claws are entirely black; on the manus that of the third digit is 30 mm. and on the pes that of the fourth digit is 35 mm. long. The male differs from the female in being considerably larger and usually somewhat lighter in colour. Old males nearly always have the chest almost white.

The skull presents some remarkable and constant characters, which serve to distinguish it at once from that of *M. giganteus*. In general it may be said that the great breadth of the posterior portion of the skull and jaws in *M. fuliginosus* readily distinguishes it from the mainland Grey kangaroo. This distinction is very easily appreciated by an examination of the skulls of the two species, and becomes obvious in a series of measurements. It is illustrated in scale drawing at Figure 181. The posterior nares are considerably lower than they are in *M. giganteus*, the breadth of the opening exceeding the height, whereas the reverse is usually the case with *M. giganteus*. The external pterygoid processes are shorter, stouter,

and more strongly everted than they are in the skull of any other kangaroo with which I am acquainted.

In *M. giganteus* the naso-palatine foramina are situated well behind the incisive canals; in *M. fuliginosus*, in contrast to *M. giganteus*, they are situated alongside the hind ends of the canals. Moreover, the maxillary-premaxillary suture, which in *M. giganteus* runs backwards some distance from the incisive canals before it turns laterally across the palate, runs obliquely backwards and outwards from the hind end of the canals in *M. fuliginosus*. (*See* Figure 174.) The nasal bones are relatively short.

These features serve at once to differentiate the skulls of the two species; but in addition to them there is the remarkable size and specialisation of the last upper incisor tooth, a feature to which Desmarest directed attention. His statement that " dans la mâchoire superieur, les quatres incisives intermediaires sont beaucoup plus petites que les laterales " may be rendered more precise by saying that the length of the last incisor exceeds the combined lengths of the two anterior incisors. This great size of the last incisor distinguishes the species from all other Kangaroos, for although the last incisor of *M. giganteus* is a highly specialised tooth, it falls considerably short of that of *M. fuliginosus*. (*See* Figure 182.)

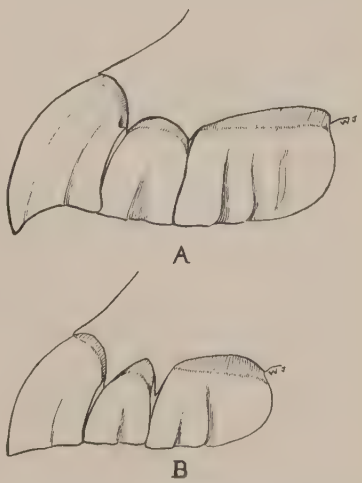

FIGURE 182.—The upper incisor teeth of the left side of A. *Macropus fuliginosus* and B. *Marcropus giganteus*. The skulls are of the same length and are of animals of the same age. Twice natural size.

The animal grows to a very great size, and it is safe to say that no really large specimen has ever been examined by a zoologist. Skull No. 1 with a basal length of 187 mm. belonged to an animal which measured 8ft. 2in. (2,450 mm.) from nose to tail in the flesh. This specimen was not considered to be by any means a large one by men familiar with them, and since its fourth molar was only just beginning to erupt it was a fairly young animal. I have seen a living animal which I believe far exceeded this specimen. The skins of a typical young male and an older one (the latter measured by Mr. May) from Flinders Chase have the following

DIMENSIONS.

	(A)	(B)
Head and body	1,450	1,650
Tail	850	850
Hind foot	320	330
Ear	120	120

DIMENSIONS OF SKULLS FROM KANGAROO ISLAND.

	1 F.W.J.	2 S.A. Mus.	3 S.A. Mus., No. M. 1985.	4 F.W.J.	5 F.W.J.	6 S.A. Mus., No. M. 1890.	7 S.A. Mus., No. M. 1893.	8 S.A. Mus., No. M. 1892.
Basal length	187	180	162	156	156	152	144	140
Breadth	100	101	92	88	—	85	82	85
Nasals, length.....	72	67	55	56	53	52	52	55
Palate length	125	120	103	99	101	98	94	92
Diastema	56	53	42	42	42	41	42	42
Length of I^3	13	12·5	12·5	13	13	11	11	11
Width of back of lower jaw	100	100	91	90	—	85	84	83

None of these skulls belongs to an old adult. In No. 1, the largest of the series, the fourth molar is only just erupting. The remaining skulls are considerably younger.

Seen in its natural haunts it is a lumbering, rather stupid looking creature, clumsily built, and of slow movement. It must be by far the slowest of all the kangaroos and, as in the days of Péron, it is still easily run down in a comparatively short distance by a very ordinary dog. Many people must have heard, with varying degrees of incredulity, the stories of kangaroos picking up a dog and hurrying with it to the nearest waterhole wherein they plunge the dog and hold it under till drowned. In the case of *M. fuliginosus* this habit is a very real one, and every season the men who hunt these animals lose dogs in this manner. In the ordinary way, however, this kangaroo is the most gentle, and the quietest of all its kind. In captivity it shows little of the restlessness which characterises some, or of the truculence which distinguishes others. It is a placid creature, "innocent et foible" in 1924 as it was, when Péron described it, in 1802. Upon the western end of Kangaroo Island it lives in the densest bush composed of *Eucalypti* and *Melalenca*, or in the scrubs of *Callistemon* and *Xanthorrhoea*, and comes out into the open grass-covered spaces to feed. It is by no means strictly nocturnal, and in the thicker parts of the bush it is not particularly shy. As a rule it is seen either solitary or in pairs, but occasionally small parties congregate in the open grassy places in the island. It breeds only once a year, the young is born as a rule in January and remains in the pouch until October.

Macropus fuliginosus still exists in some thousands on Kangaroo Island, and fortunately it is probable that quite half the kangaroo population is living on the reserve of Flinders Chase, which consists of some 200 square miles of broken bush-covered country at the western end of the island. Outside the reserve the legislation only grants the animal partial protection, the open season being from April 1st to September 30th. This lack of total protection is much to be regretted.

During the open season the kangaroo is killed very freely. In 1922 two men slaughtered 600 on a rather limited holding, and during the present season 300 more were killed at the same place. These animals are skinned for the leather trade. Although its tenure of existence appears assured within the sanctuary of Flinders Chase, the indiscriminate slaughter of this fine animal on other parts

of the island is much to be deplored. It is hoped that a full measure of protection will one day be accorded to the species throughout the whole of its island home.

The history of this species is a curious one. Flinders gives a good account of it as he saw it on March 22nd, 1802, and Péron, who visited Kangaroo Island between December 27th, 1802, and February 1st, 1803, adds many details of interest concerning it. Péron took specimens to Paris, and in 1817 Desmarest described these specimens and named the animal *fuliginosus*. Gould in 1863 expressed his doubts that the animal was still living on Kangaroo Island; and in 1871 Krefft stated that it was no longer to be found there.

In 1888 Oldfield Thomas, speaking of *M. giganteus var fuliginosus*, says, "This is obviously the usual Tasmanian climatic variety of the common kangaroo, and its modifications are just those which might have been expected. The original habitat of this form was said to be Kangaroo Island, South Australia, where Desmarest states, but with some doubt, that it was obtained by Péron and Lesueur. This doubt is confirmed by the fact that (*fide* Gould) it does not exist on Kangaroo Island, and by its common occurrence in Tasmania, where those collectors spent a considerable time." Later writers such as Ogilby (1892), Lydekker (1894), Lucas and Le Souef (1909), and Angel Cabrera (1919), do not even mention the possibility of its ever having lived on Kangaroo Island, or of the original specimens having come from there. They one and all assume that the Tasmanian animal is the type of the species and the only representative of it that has ever existed. Yet all the while that Gould's by no means dogmatic statement was being copied from book to book and gaining an air of finality in the process, the animal was living on Kangaroo Island, and its pelts were coming regularly into the salerooms of Adelaide, where, instead of being preserved as Museum specimens for a permanent memorial of the species, they became absorbed into the fur or the leather trade as the perfection of the pelage dictated.

It seems that there can be little room to doubt that the big Kangaroo of Kangaroo Island is the original type of *M. fuliginosus* and the same animal that was so graphically described by the early navigators. It is an animal that South Australians should be proud of, and do all in their power to protect and keep in perpetuity in its island sanctuary.

BRACHYDONT SECTION.

Genus 7.—SETONYX (Lesson, 1842).

This Genus contains only a single species which has commonly been included in the Genus *Macropus*. Its dental characters, however, separate it from all the other members of that Genus. The single species *Setonyx brachyurus* (the Short-tailed Wallaby) is a small Western Australian wallaby, not found in this State.

Genus 8.—DENDROLAGUS (Schlegel and Müller, 1839).

This Genus contains the beautiful Tree Wallabies, of which there are eight distinct species, all of which are confined to New Guinea or to tropical Queensland.

GENUS 9.—DORCOPSIS (Schlegel and Müller, 1839).

The members of this Genus are confined to New Guinea. They may be defined as wallabies which, having become adapted or readapted to an arboreal habitat, like the members of the Genus *Dendrolagus*, have reverted to a terrestrial saltatory mode of life.

FAMILY III.—PHASCOLOMYIDAE.

This Family, the third and last of the *Syndactyla diprotodontia*, contains only the Wombats, and these animals constitute one of the most curious and aberrant groups of the marsupials. Their correct position in any scheme of classification is a matter of some doubt, and very varying opinions have been put forward as to their true relationships. In certain features they show considerable likeness

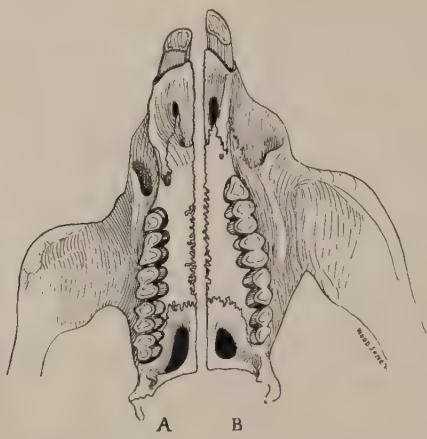

FIGURE 183.—The palate and teeth of A. *Lasiorhinus latifrons* and B. *Phascolomys mitchelli*. Half natural size.

to the Koala, and in some ways may be considered as terrestrial "Native bears." But in several important characters they differ so widely from these animals that the method of uniting them into a single family is not followed here. The Wombats differ from all other living marsupials in having only a single incisor tooth upon each side of both the upper and lower jaws (*see* Figure 183) and in having all the teeth rootless and persistently growing. Both of these conditions are frequently met with in the Monodelphian Rodents, but they occur only in the Wombats among the Didelphians. The dental condition of the Wombats shows the most remarkable parallelism in development to that of certain of the Rodents, and affords a most striking example of the similar modification of structure in response to similar demands of function.

Apart from the peculiarities of the teeth, the members of the Family are distinguished by possessing the following characteristics. The build is stout and clumsy. The limbs are short and stout, and of exceptional strength. There are five digits on both manus and pes, but on the pes the hallux is poorly developed. The tail is reduced to a mere rudiment. The number of ribs is large. The skull is massive, peculiarly flattened, and the bullae are very small and imperfect. The animals are terrestrial, fossorial, and nocturnal. They are confined to the southern portion of the continent of Australia, to the islands of Bass's Straits, and to Tasmania. The Family is best divided into two genera, distinguished as follows :—

External characters.—

(A.) Rhinarium naked. Coat coarse and harsh.

Genus 1. *Phascolomys.*

(A^1.) Rhinarium hairy. Coat soft and silky.

Genus 2. *Lasiorhinus.*

Osteological characters.—

(A.) Post orbital processes rudimentary or absent. Greatest breadth of nasals less than their length. Ribs 15 in number.

Genus 1. *Phascolomys.*

(A^1.) Post orbital processes strongly developed. Greatest breadth of nasals equal to or greater than their length. Ribs 13 in number.

Genus 2. *Lasiorhinus.*

The history of our knowledge of the Wombats is curious. These large, lumbering animals, which make such conspicuous burrows, were extremely late in being brought to the notice of zoologists.

Although *Phascolomys ursinus* has woven itself into Australian history, from its associations with Bass in his adventurous voyage into the Straits, and has left its imprint strongly on the pages of early Victorian comparative anatomy, the recognition of the various species was delayed in a very remarkable manner.

It seems strange that at the time when the minute and obscure Fat-tailed Pouched Mouse (*Smintlioj)sis crassicaudata*) was a well known and adequately described form, the South Australian Wombats were quite unknown as living animals, *Phascolomys mitchelli* being known only from fossil fragments, and *Lasiorhinus latifrons* only from a single skull.

The habits of all species are apparently so similar that they will be dealt with as a whole after the generic and specific characters are discussed.

Genus 1.—PHASCOLOMYS (Etienne Geoffroy, 1803).

This Genus contains four species, of which *P. ursinus* (Shaw, 1800), the first of all the Wombats to be made known to science, is confined to the islands of Bass's Straits. *P. tasmaniensis* (Spencer and Kershaw, 1910) inhabits Tasmania only, *P. gillespiei* (De Vis, 1900) is limited to Queensland, and *P. mitchelli* (Owen, 1838) ranges through New South Wales and Victoria and extends into South Australia.

Common Australian Wombat.

PHASCOLOMYS MITCHELLI (Owen, 1838).

Size large. Coat fairly long, but coarse and harsh. Under-fur sparse or absent. General colour of coat somewhat variable, but usually a grizzle of buff and black.

FIGURE 184.—Rhinarium of *Phascolomys mitchelli*. Two-thirds natural size.

The animal is uniformly coloured buff, grizzled buff, or nearly black, and has no markings anywhere on the body. The rhinarium is large, naked, and its limits are sharply defined. (*See* Figure 184.) The ears are short and simple. (*See* Figure 185.) The manus with naked and coarsely granular palm; pads not well differentiated. Claws long and strong. Digital formula $3 > 4 > 2 > 5 > 1$. (*See* Figure 186.) The pes with coarsely granular, naked, sole. Pads ill defined. Claws long. Syndactylous digits very well developed. Digital formula $2{\cdot}3 > 4 > 5 > 1$. The hallux bears no nail. (*See* Figure 187.) Facial vibrissae extremely well developed and taking the form of coarse brownish bristles. All sets well represented, the supraorbitals measuring 77 mm. and the mysticials 97 mm. Eyelashes are sparse or absent, the pupil is circular, the iris dark-brown. The pouch extends more in front of the opening than it does behind. The nipples are two in number.

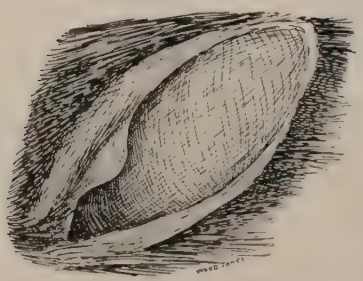

FIGURE 185.—Left ear of *Phascolomys mitchelli*.

The skull is large and massive. The infraorbital foramen is narrow and slit-like. Nasal bones large, expanded posteriorly, their greatest breadth about three-fourths of their length, their posterior margins bowed backwards in the centre. Interorbital region smooth, evenly convex, its edges sharp, well-defined, and continued backwards as ridges over the temporal region to the occiput. (*See* Figure 188.) The post-orbital processes rudimentary.

DIMENSIONS.

	Full-grown Male
Head and body	♂ 1,150
Hind foot	110
Ear	45

DIMENSIONS OF SKULL.

	Brit. Mus.	Brit. Mus. Mt. Gambier.	Murray Bridge.
Basal length	185	161	162
Breadth	145	135	142
Nasals, length	81	70	58
Nasals, breadth	55	49	48
Palate length	125	106	102

Phascolomys mitchelli has the great distinction among animals in that it was known as, and named from, a fossil specimen long before the animal was known to be still living. The fossil remains of this creature were found by Sir Thomas Mitchell in the caves of Wellington Valley, New South Wales, and together with the remains of

FIGURE 186.—Left manus of *Phascolomys mitchelli*.

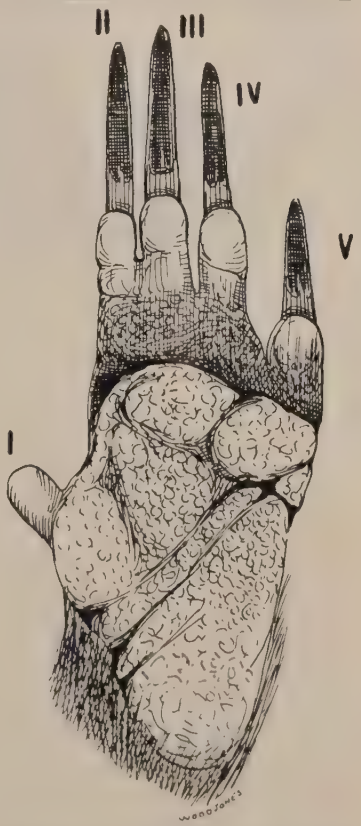

FIGURE 187.—Left pes of *Phascolomys mitchelli*.

the *Diprotodon* and other extinct marsupials they were submitted to Professor Owen.

At that time (1838) the only living Wombat known was *Phascolomys ursinus*, and Sir Richard recognised that Major Mitchell's fossil animal from the Wellington Caves was different from the living animal of the islands of Bass's Straits, and he named it in honour of its discoverer as *Phascolomys mitchelli*, and regarded it as an animal which had ceased to exist along with the *Diprotodon*.

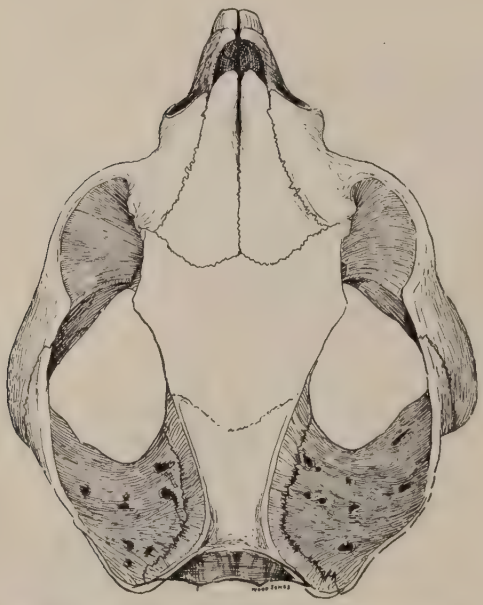

FIGURE 188.—Dorsal view of the skull of *Phascolomys mitchelli*. Half natural size.

Although the newspapers frequently hold out to us the dramatic possibility of animals long regarded as extinct being captured in the dismal swamps of Central Africa or the wilds of South America, *Phascolomys mitchelli* still holds its great distinction of being the only mammal which was originally described as a fossil and which subsequently proved to be a living creature.

GENUS 2.—LASIORHINUS (Gray, 1863).

This Genus contains only a single species, a peculiarly South Australian animal, *Lasiorhinus latifrons* (Owen, 1845), known from the peculiarities of its rhinarium as the Hairy-nosed Wombat. (*See* Figure 189.)

Hairy-nosed Wombat.

LASIORHINUS LATIFRONS (Owen, 1845).

Size somewhat smaller than that of *Phascolomys mitchelli*. The coat is fairly long, soft, and silky. General colour grizzled-grey, but the whole animal not uniformly coloured as are the members of the preceding Genus. Face grey, tip of muzzle sharply differentiated, pale, almost white; the eye also delimited above and below by whitish patches. Ears comparatively long and narrow; hair around their bases white. Dorsal surface somewhat dappled, greyish, darker over the scapular region than over the hind quarters. Chin dark, cheeks, neck, and chest white, ventral surface and under portion of the body grey.

Limbs dark grizzled-grey on the outer side, white on the inner side. Syndactylous digits longer than in *Phascolomys mitchelli*.

Skull broad, flattened, and massive. The infraorbital foramen is comparatively widely open, triangular or oval, not slit-like as in *Phascolomys*. Nasal bones short,

FIGURE 189.—Rhinarium of *Lasiorhinus latifrons*.

broad, and expanded behind, their greatest breadth equal to or greater than their length, their posterior margins almost directly transverse. The interorbital region flattened or concave in the centre. Post-orbital processes prominent and well developed. (*See* Figure 190.)

DIMENSIONS.

	Full-grown Male.
Head and body	♂ 900
Hind foot	95
Ear	70

DIMENSIONS OF SKULL.

	Brit. Mus. R. Murray, S.A.	F.W.J.	F.W.J.
Basal length	167	162	160
Breadth	144	128	126
Nasals, length	65	55	56
Nasals, breadth	67	63	58
Palate length	110	98	90

The Hairy-nosed Wombat has not the distinction, which appertains to *Phascolomys mitchelli*, of having been described as a fossil before it was known as a living animal;

but it has the next best claim, since it was known from a single skull many years before the actual animal was examined by zoologists.

FIGURE 190.—Dorsal view of the skull of *Lasiorhinus latifrons*. Half natural size.

When Sir Richard Owen named the species he had only a single skull, sent to him from Mount Gambier, before him. He recognised that this skull differed from that of *Phascolomys ursinus*, which was the only other recent Wombat then known, in the great breadth of the frontal portion of the skull, and he therefore named the animal to which this solitary skull belonged as *latifrons*. From this skeletal peculiarity the animal was given the book name of Broad-fronted Wombat; but this popular name is now replaced by the designation of Hairy-nosed Wombat, since this name sums up the specific and generic characters of the peculiar South Australian species.

The Hairy-nosed Wombat is peculiar to South Australia and the eastern border of Western Australia, and Mitchell's Wombat is widely distributed in the southern portion of New South Wales, Victoria, and South Australia.

In South Australia the two animals overlap and, so far as can be ascertained, no details of their precise distribution have ever been recorded: nor do any observations appear to have been made as to whether the two species ever occupy the same territory or inhabit adjacent warrens, or on the other hand remain confined to definite and restricted areas. The only attempt that can be made here to define their distribution is to record the comparatively few localities from which specimens have been received by various institutions.

The following records stand for *Phascolomys mitchelli*: Mount Gambier (Brit. Mus. and S.A. Mus.), Lake Alexandrina (Brit. Mus.), Murray Bridge (F.W.J. and S.A. Mus.), Mount Schank (S.A. Mus.), and Robe (S.A. Mus. and F.W.J.).

Lasiorhinus latifrons has been recorded from Port Augusta (Brit. Mus.), Port Lincoln (Brit. Mus.), River Murray (Brit. Mus.), River Light (Brit. Mus.), Fowler's Bay (S.A. Mus.), Yorke Peninsula (S.A. Mus.), Blanchetown (S.A. Mus.), Blyth (S.A. Mus.), Nullarbor Plains (S.A. Mus.), Eucla (S.A. Mus. and F.W.J.).

From this small amount of information it is not safe to generalise, but it would seem that *latifrons* lives over the northern part of the State from Western Australia to the Murray, and that *mitchelli* lives mostly in the South and South-East, the meeting of the two animals being upon the common ground of the Murray.

Wombats are nocturnal animals, shy and cautious, and exceedingly difficult to observe. But little intimate study seems ever to have been made of their habits, and although they are commonly present in the collections of the Zoological Gardens in Australia, I am not aware of any great additions to our knowledge having accrued from observations made on these captive animals.

The burrows which they inhabit are always easy to identify, firstly from their size and secondly from the form of their entrance, which is not circular, but, like those of the Platypus, is in the form of a low, flattened arch. I am not aware of any observations upon the system of the burrow or the relation of the breeding chamber to the general meshwork of tunnels. They appear to breed but once in the year and a single young is produced at a time.

Concerning the disposition of the animal itself, there is, first, the excellent and historical account of Bass's capture of *ursinus* on Cape Barren Island. The capture was effected easily, for " by placing his hands under its belly, he suddenly lifted it from the ground and laid it upon its back upon his arm as a child would be. It made no noise, nor any effort to escape, not even a struggle. The countenance was placid and undisturbed, and it seemed as contented as if it had been nursed by Mr. Bass from its infancy. He carried the beast upwards of a mile, and often shifted him from arm to arm, sometimes laying him upon his shoulder, all of which he took in good part until, being obliged to secure his legs while he went into the bush to cut a specimen of a new wood, the creature's anger arose with the pinching of the twine. He wizzed with all his might, kicked and scratched most furiously, and snapped off a piece from the elbow of Mr. Bass's jacket with his grass-cutting teeth. Their friendship was here at an end, and the creature remained implacable all the way to the boat, ceasing to kick only when he was exhausted." One may be pardoned for thinking that this is a better account of Wombat nature than anything that has been written on the hundreds of animals that have lived and died in the Australian Zoological Gardens since that time.

Another historical Wombat was the one brought home from one of the islands in Bass's Straits by " Mr. Brown, the eminent botanist attached to Flinder's voyage."

This animal " lived as a domestic pet in the house of Mr. Clift " (of the Royal College of Surgeons of London) " for two years." It was upon this animal, whose acquaintanceship with distinguished anatomists must have been very large, that Sir Everard Home made his observations. Of this animal Home recorded that " it burrowed in the ground whenever it had an opportunity and covered itself in the earth with surprising quickness: it was very quiet during the day, but constantly in motion in the night; was very sensible to cold: ate all kinds of vegetables, but was particularly fond of new hay, which it ate stalk by stalk, taking it into its mouth like a beaver, by small bits at a time. It was not wanting in intelligence, and appeared attached to those to whom it was accustomed and who were kind to it. When it saw them it would put up its fore paws on their knees, and when taken up would sleep in the lap. It allowed children to pull and carry it about, and when it bit them it did not appear to do it in anger or with violence."

These two accounts of the Wombat are over a century old, and as Lydekker noted in 1894, though Sir Everard Home wrote so long ago as 1808 " it does not appear that fresh observations have been recorded."

Surely it is high time that the authorities responsible for our Zoological Gardens, in which these easily kept animals are always confined (a century ago one lived for over five years in London) produced some fresh details of the intimate life of these animals, and our field naturalists recorded something of its life in the wild. The Wombat is an excessively powerful animal, its perfection of muscular development being one of the wonders of comparative anatomy. It is this extraordinary muscular power which enables it to dig its large tunnels into the very hardest sort of ground. It also possesses a good tough skin, and so it could probably hold its own under present day conditions, and with existing introduced enemies, if only it had adequate protection from man. That Wombats are harmless to small holders is not contended. So bulky an animal which drives tunnels with such ease is not, of course, desirable in closely settled or intensively worked agricultural areas. But South Australia possesses vast tracts where Wombats might burrow and live without detriment to any human enterprise. In these areas they need protection from man alone. *Lasiorhinus latifrons* belongs to South Australia almost exclusively. This State has been the sole custodian of *Myrmecobius rufus*, which is extinct, of *Caloprymnus campestris*, which is also extinct, and of *Wallabia greyi*, which is on the very verge of extinction. This is no very creditable record. The record would be worse if *Lasiorhinus latifrons* were to join these others and be added to the list of animals, peculiar to this State, which had been allowed to pass into the category of " exterminated within recent years."